AUTOMATION

JANUARY 1959

SURVEY REPORT AND

Automation Forecast

The Magazine of Automatic Operations

- Applying an Automation Philosophy
- Automating Centerless Grinders
- Multispindle Torquing Equipment
- Overhead Conveying System

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A PENTON PUBLICATION

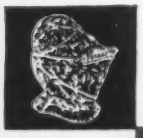
Master mechanics like the Wean "Flying Press" as much as presidents do

The Wean "Flying Press" does one thing extremely well: it produces stamped parts at absurdly low costs per piece. This pleases management because the cost reduction it makes possible helps widen the profit spread in finished products.

To find the reason for the master mechanic's satisfaction, we must examine the operating characteristics of the "Flying Press," a difficult job to do in print. First, the "Flying Press" is completely unique among stamping presses, producing parts from coil without stop-and-go indexing at the press. But, far from making the equipment *more* difficult to operate, this "Flying Press" principle eliminates the use of clutch, brake and fly-wheel; all points of potential press break-down! And there's less danger of die breakage with the "Flying Press," both during set-up and operation, since automatic devices to protect the tooling are built-in.

We could go on with a list of many other advantages which the Wean "Flying Press" offers over ordinary designs, but there's just too much to cover. However, we have summarized the general points of superiority in a booklet which we'll gladly send you. If you'd prefer, one of our sales engineers will be glad to discuss the "Flying Press" in regard to your specific production at your convenience.

May we hear from you, to send the booklet or call?



WEAN

WEAN EQUIPMENT CORPORATION

CLEVELAND 17, OHIO

Detroit • Chicago • Newark

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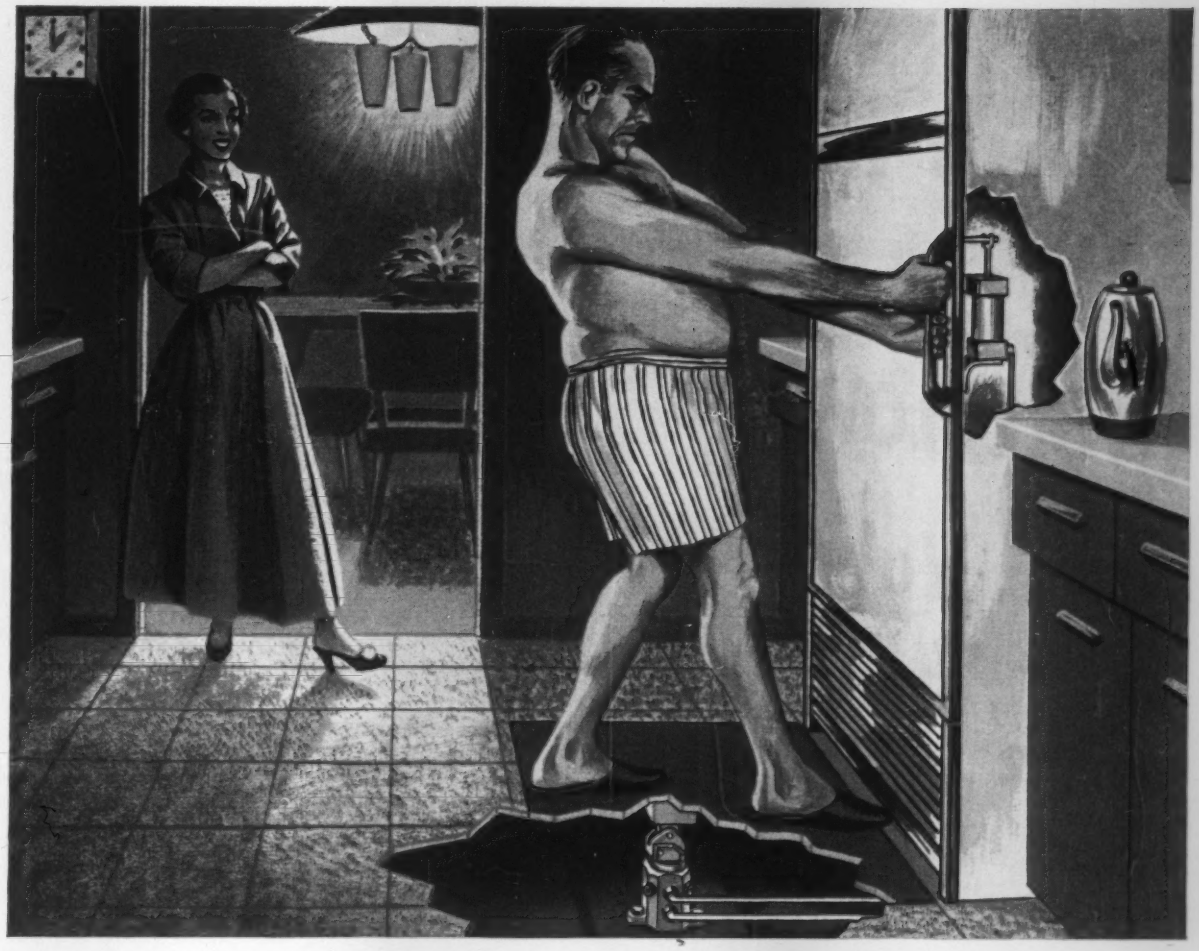


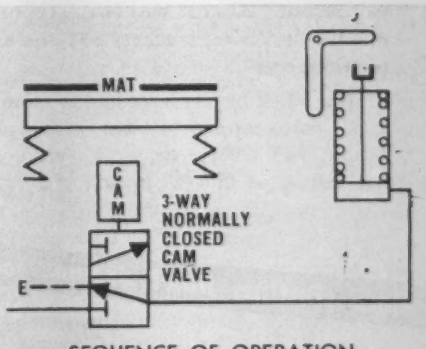
What? Air Won't Let Him Get Too Fat!

We admit we are not serious, but . . .

In a previous moment of strength he has set the controls—now, if he weighs over 200 pounds when he steps on the mat in front of the refrigerator, the door just won't open. But while he is under 200 pounds, no trouble. Now, it's highly unlikely that the refrigerator folks will be mobbed by eager buyers for such a diet-master model, but we have jumped on it as a good chance to show how a cam valve can say "yes" or "no."

Ross Cam Valves can "think" for your circuits, too

Cam valves are the key to air automation. They can act on almost any mechanical signal to set off . . . or restrict . . . another operation. Then still another cam valve can interlock that circuit with yet further operations and so on until any number of operations can be sequencing one another. Are you realizing the full possibilities from cam valves? The Ross line includes so many models, we invite you to call your Ross representative or write us.



SEQUENCE OF OPERATION

Sufficient weight on mat depresses cam, operating valve and moving cylinder to point where it restrains door handle from opening.

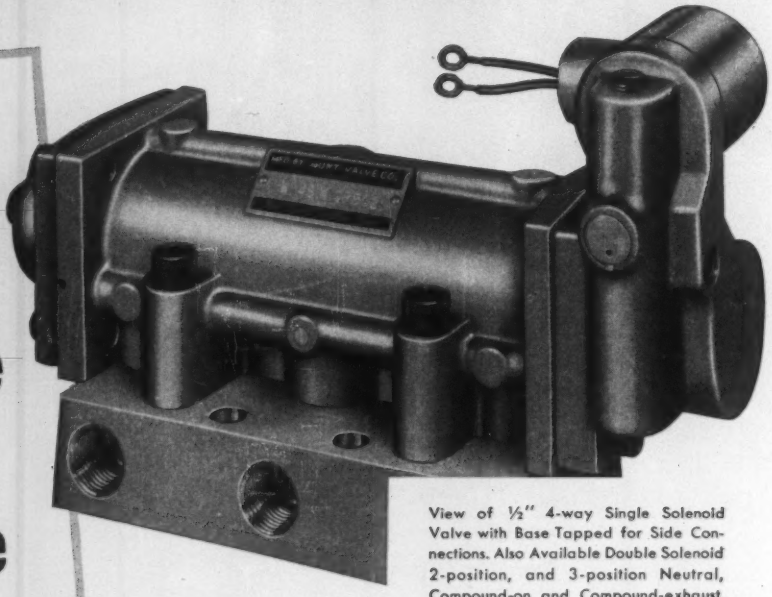
ROSS OPERATING VALVE CO. 131 E. Golden Gate Ave. • Detroit 3, Michigan

Circle 654 on Page 129

HUNT

sets the pace again...

with a
FULL FLOW
½" Valve
at a
½" Price



View of ½" 4-way Single Solenoid Valve with Base Tapped for Side Connections. Also Available Double Solenoid 2-position, and 3-position Neutral, Compound-on and Compound-exhaust.

. . . in a completely comprehensive range of valve actions

THE UNIVERSAL SIZE. We asked O.E.M. buyers, large and small users; men out in the plant and plant managers,—"If you had to standardize on just one size of control valve, what size would you select?" Almost without exception they replied;—"½" size, it meets 85% or more of our requirements".

UNTIL NOW buyers have had to choose between a ⅜" valve tapped ½" but with **only ⅜" flow** (about 167 CFM); or, a ¾" valve tapped ½" but **selling at the ¾" price.**

AGAIN HUNT LEADS. Now, from Hunt, you can get a **full flow ½" valve** (257 CFM at 100 psig) in a complete range of actions, 2-way, 3-way, 4-way and 5-way, including single and double solenoid in AC or DC, any voltage, any cycle, explosion proof solenoid if desired; also hand lever, double pilot, pilot operated automatic return, and mechanically operated both directions, or with automatic return.

GET FULL DETAILS NOW about these new Hunt Valves that give you the flow you need, in the action you want, **at a ½" rather than ¾" price.**

More startling HUNT designs to come!

Send for Bulletin No. 582-A TODAY!

HUNT

40 YEARS

Quick-As-Wink® AIR AND HYDRAULIC CONTROL *Valves*

Manufactured by HUNT VALVE COMPANY, 2073 East Pershing St., Salem Ohio

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JANUARY 1959
Vol. 6 — No. 1

AUTOMATION®

A PENTON PUBLICATION

The Magazine of Automatic Operations

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automation outlook

PLANT MODERNIZATION

". . . with a given percentage of net profit reinvested, and taking into account the present level of corporate taxes and inflation as expressed in the construction cost index, a plant which formerly could be replaced every seven years without new capital must henceforth give about 30 years of service. Obviously, this plant must be kept competitive with newly built plants during its entire physical life. . ."—*Clarence H. Thayer, vice president in charge of manufacturing, Sun Oil Co., see page 44.*

TOOLING FOR PRODUCT CHANGES

". . . one point to consider when upgrading standard machine tools is that all tooling added to capital equipment—whether purchased as original equipment or supplied later—must be classified as expendable. The intense competition which presently exists in the consumer goods industries has resulted in a more frequent demand for model changes than has existed in the past. These changes have sharply accelerated the rate of obsolescence of special tooling. Therefore, the selection of elements to upgrade machinery should be made from versatile components that can be switched or slightly modified to accommodate model variations. Careful selection will hold down the cost of retooling for different models and extend the life of the special tooling. . ."—*J. Llewell Jessup, president, JEDCO Inc., see page 56.*

GROWING OCCUPATIONAL GROUP

". . . employment of technicians is likely to continue to expand over the long run as a result of the further growth of industry and the increasing complexity of modern technology. As products and the methods by which they are manufactured become more complex, the need for workers with a technical background including some theoretical knowledge will be intensified. . ."—*VA Pamphlet 22-1, Veterans Administration.*

INADEQUATE DEPRECIATION ALLOWANCES

". . . one of the fundamental problems in this area of replacing and modernizing steel production facilities is that of depreciation. In an inflationary period such as we have had, and which we continue to have, it becomes absolutely impossible for any industry to recover, through depreciation, the replacement cost of production equipment. In every year since 1939, for example, the wear and exhaustion—or depreciation—recorded by U. S. Steel has failed to equal that needed for the recovery of the original buying power of the investment used up in production. . ."—*C. F. Hood, president, United States Steel Corp.*

SEMICONDUCTOR USES EXPANDING

". . . an extremely high potential use of transistors and diodes is in the field of industrial computers. This field extends from desk calculators to the most sophisticated digital computers for industrial and scientific use. Transistors and diodes are now entering computers and will replace all electronic tubes before the close of the second decade. Automation in industry and in the home will be extended and accelerated through semiconductor electronics. . . "—*Mervin J. Kelly, president, Bell Telephone Laboratories Inc.*

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(Clearwater) 39-9493

London, S.W. 1 ....2 Caxton St., Westminster

Published by
THE PENTON PUBLISHING COMPANY

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R. C. JAENKE .....President
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Subscriptions in United States, possessions and Canada for home-addressed copies and those not qualified under above rules: One year $10. Single copies $1.00. Other countries: One year $20.

Published monthly and copyrighted 1959 by The Penton Publishing Co., Penton Bldg., Cleveland 13, Ohio. Accepted as Controlled Circulation Publication at Cleveland, Ohio.

When requesting changes of address, etc., please allow four to six weeks for processing.

BPA NBP

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. . . Fluid Power news

REPORT NO. 12,103
"HYTAC"* SYSTEMS ON NEW PAPER MACHINE

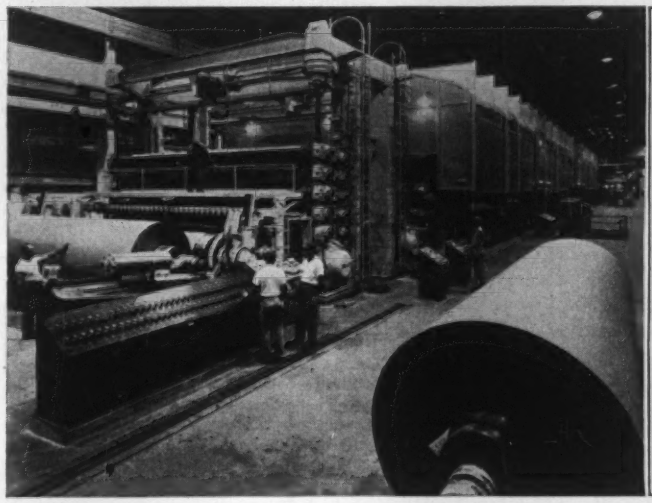
From Oilgear Application-Engineering Files

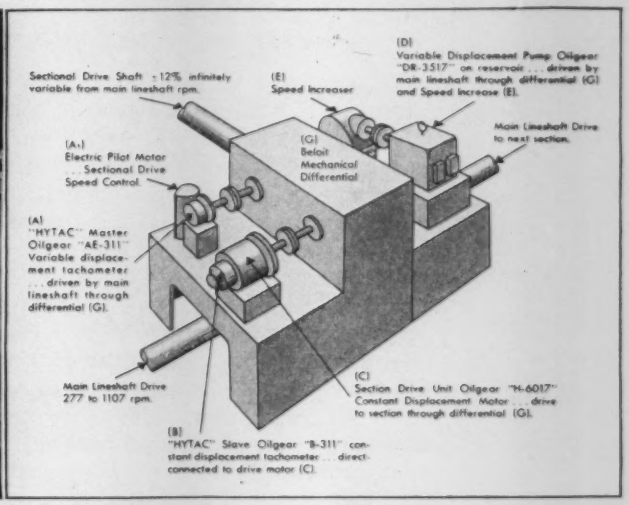
HOW OILGEAR "*ANY-SPEED*" DRIVES ON NEW PAPER MACHINE ACCURATELY CONTROL SECTION SPEEDS

USER: *West Virginia Pulp and Paper Company (Westvaco) (Builder—Beloit Iron Works, Beloit, Wisconsin)*

DATA: Systems to individually vary and accurately control speeds on four sections of a new, 264-in., $25,000,000 paper machine that will produce up to 225 tons daily of a revolutionary, patented, smooth, extensible kraft sheet. Machine is powered from a block-long main lineshaft with mechanical differentials at each section. Main lineshaft speed will vary over a 4:1 range—from 277 to 1107 rpm.

REQUIREMENTS: 1. A system that, when applied to each of four mechanical differentials, will provide individual, precision-controlled, infinitely variable increase or decrease of 10% over or under main lineshaft speed—as selected from 2 local, and 7 remote push-button stations. 2. Each system to maintain selected speed for its section within ±0.25% max. variation over a 50% load change at max. lineshaft speed. 3. Systems must also be: a. Compact. b. Impervious to moisture and daily high-pressure "wash-down." c. Thrifty on electrical power input. d. Trouble-free for continuous, heavy-duty, full-production paper machine drive service.



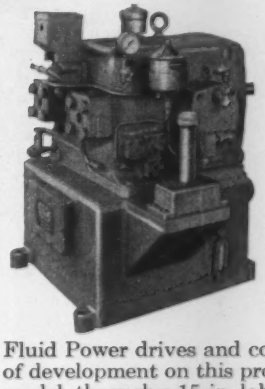

(D) Variable Displacement Pump Oilgear "DR-3517" on reservoir . . . driven by main lineshaft through differential (G) and Speed Increase (E).
Sectional Drive Shaft ±12% infinitely variable from main lineshaft rpm.
(E) Speed Increaser
Main Lineshaft Drive to next section.
(G) Beloit Mechanical Differential
(A1) Electric Pilot Motor . . . Sectional Drive Speed Control.
(A) "HYTAC" Master Oilgear "AE-311" Variable displacement tachometer . . . driven by main lineshaft through differential (G).
Main Lineshaft Drive 277 to 1107 rpm.
(C) Section Drive Unit Oilgear "H-6017" Constant Displacement Motor . . . drive to section through differential (G).
(B) "HYTAC" Slave Oilgear "B-311" constant displacement tachometer . . . direct-connected to drive motor (C).

SOLUTION: *Application-Engineered* Oilgear *Hytac** (hydraulic tachometer) controlled drives provide precise, individual speed control on each of four sections—3rd dryer, 1st calender, 2nd calender, and winder reel of Westvaco's new #3 kraft machine shown above. Drawing, above right, shows components of typical sectional drive. *These highly accurate, compact, heavy-duty systems have met or exceeded all originally specified requirements.* Examples: 1. Specified ±10% infinitely variable sectional speed control range exceeded by providing ±12% in actual operation. 2. Selected speeds are maintained within specified limits *regardless* of load change. 3. Production speeds increased to over 2000 fpm. Important "Oilgear-plus" features are: 1. Dual winder control that, with the mere flip of a control panel switch, converts winder drive from speed-controlled to tension-controlled . . . speed control prevents tearing the tail strip when starting a new core, while tension control provides good roll quality at full sheet width. 2. Cushioned, controlled acceleration and deceleration. 3. Positive overload protection. 4. Pressure and flood lubrication with continuous power fluid filtration.

OPERATION: Fluid from master tach (A) gives section drive speed command to control on pump (D). Slave tach (B) feeds back a flow signal proportional to actual section drive speed. When main lineshaft speed is increased or decreased, fluid flow from master tach (A) automatically increases or decreases to command section drive to follow lineshaft speed change. Through local or remote pushbutton stations connected to electric pilot motor (A_1) on master tach (A), operator can increase or decrease speed of each *Hytac* section infinitely up to 12% of prevailing lineshaft speed.

A second Westvaco kraft machine will have an *Application-Engineered* Oilgear Controlled Motion System to cover a 10:1 lineshaft speed range, and a wider sectional speed range adjustment.

*"HYTAC" Systems—An Oilgear Trademark



Left: Oilgear Sectional Drive Pump (D) with integral reservoir. *Right:* Oilgear Sectional Drive Motor (C) with direct-connected *Hytac* slave (B) to left.

Fluid Power drives and controls were selected after three years of development on this process and machine—from a 2-in. table model, through a 15-in. laboratory model and 60-in. pilot model. Conventional variable speed drives could not provide the sectional speed control required. "*Equipped with the most advanced precision controls known to the industry . . .*"—is the statement Westvaco has made concerning their new #3 machine.

. . . for the lowest cost per year—it's Oilgear!

For similar practical solutions to YOUR linear or rotary Controlled-Motion problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY
Application-Engineered Controlled Motion Systems
1598 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

CINCINNATI

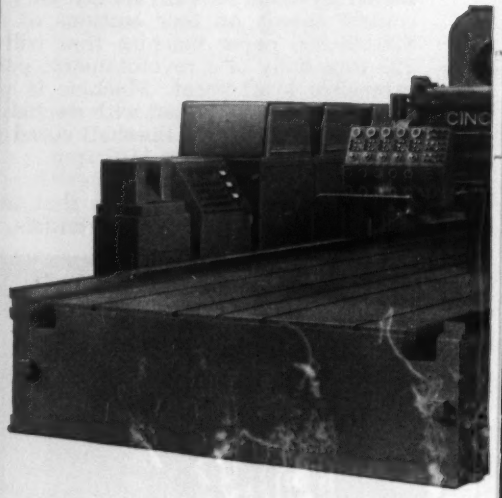
combines modern ideas with over 45 years' experience in designing and building special machinery

Cincinnati Milling's Special Machine Division has the broad experience and engineering talent to design and build special machinery and process equipment of any size and complexity. Principal functions of the Division include Engineering Service (a group of specialists who analyze the problems and prepare engineering proposals and cost estimates) . . . Special Design Engineering and product development . . . Manufacture, assembly and inspection . . . Factory run-off, using customer samples . . . Demonstration and follow-up of equipment in customer's plant.

Equipment built by the Special Machine Division incorporates the advantages of automation and numerical control, where applicable. Highly successful installations will be found in many industries . . . metalworking, paper, chemical, optical and others. Cincinnati is staffed and equipped to build equally fine cost-reducing machinery for your shop.

CINCINNATI

CINCINNATI SPECIAL MACHINES

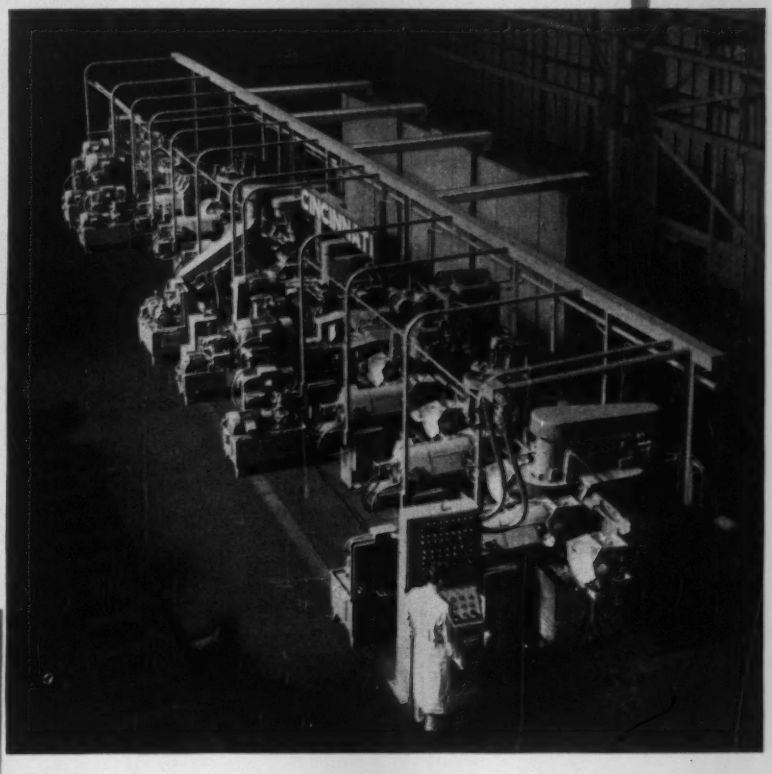


Large Numerically Controlled Milling Machine, developed and built by the Special Machine Division for the aircraft industry. An aluminum aircraft component milled on this machine is illustrated at the right. Many parts of this type are milled in ⅓ the time usually required. The machine is a gantry type, having fixed table measuring 8 ft. x 30 ft.

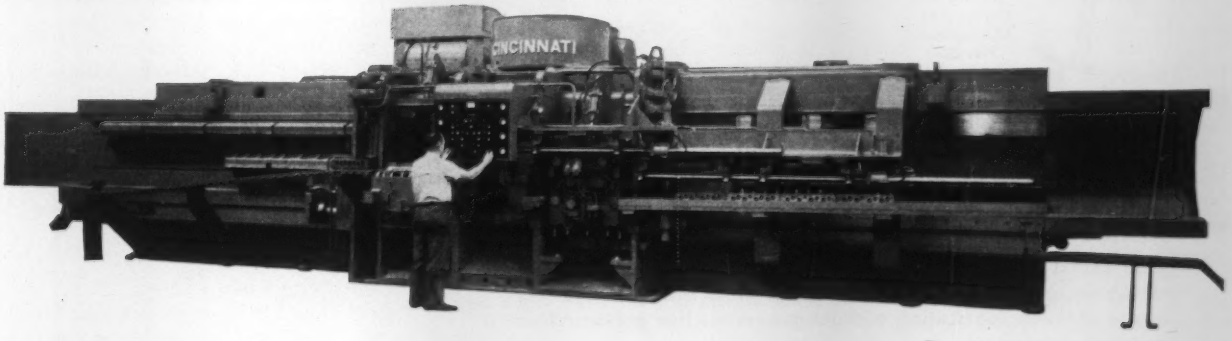
CINCINNATI Horizontal Hydro-Broach Machine, typical of the many designed and built for the automotive industry to broach cylinder heads and blocks. The machine illustrated broaches cylinder heads on the top, joint face and two manifold pads each cycle. The work progresses from the right- to the left-hand fixture. Ram speeds are adjustable, from 100 to 200 feet per min.; electro-mechanical drive; 300 hp. Production: 112 heads per hour.

CINCINNATI®

SPECIAL MACHINES • VERTICAL AND HORIZONTAL



CINCINNATI 26-Station Unit Type Transfer Line. This efficient production line automatically mills, drills and bores transmission cases in 33 operations; inserts two bushings; banks excess parts; transfers the castings from one station to the next. Several noteworthy advantages are incorporated in the line, including unit construction; one station for future engineering changes; complete static electrical control. Accuracy and finish obtained are excellent. The line cycles at the rate of 137 per hour.



BROACHING MACHINES • COMPLETE PRODUCTION LINES

SPECIAL MACHINE DIVISION
The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio

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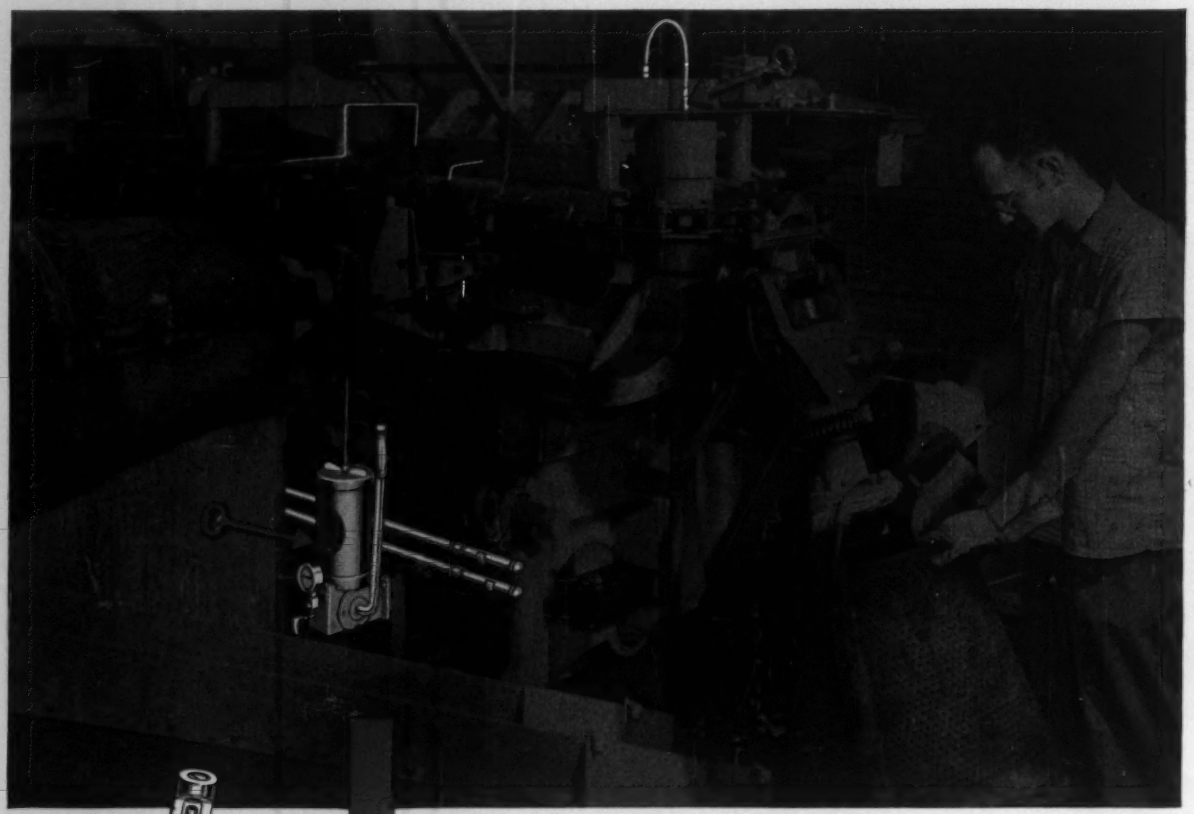
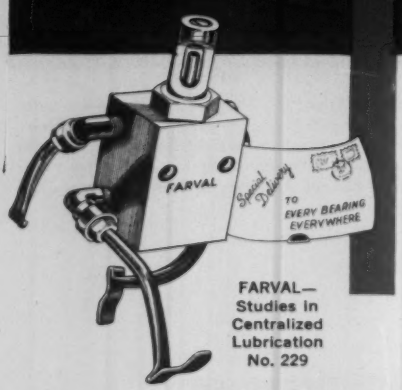




FARVAL—
Studies in
Centralized
Lubrication
No. 229

Farval cuts downtime on automatic plating machine

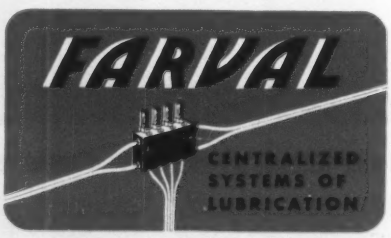
Quantity production is a prime purpose for automatic machines such as this Stevens plater. Bearing failure, long the enemy of automatic processes, is eliminated on this plating machine at a prominent Midwestern automotive parts plant through application of a Farval lubrication system. Downtime for repair of bearings is virtually eliminated.

This Farval system provides measured amounts of lubricant to each bearing at regular intervals. Large ports on Farval systems insure adequate lubrication without dangerous line pressure loss or grease separation.

Learn how you can cut downtime with an application of a Farval system to your process or machinery. Ask for revised Bulletin 26-S. Write The Farval Corporation, 3265 East 80th Street, Cleveland 4, Ohio.

KEYS TO ADEQUATE LUBRICATION

—wherever you see the sign of Farval—familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated.



Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.

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AUTOMATION news

Today's events and developments in the field of automation

Conveying Systems Speed Work And Cut Operating Costs

AUTOMATIC routing of parts and equipment is featured in a plant-wide conveying system designed into a new Western Electric Co. distribution house at Solon, Ohio. Furnished by Alvey-Ferguson Co., the co-ordinated conveying system speeds the flow of work and reduces operating costs by allowing manpower to be more productively used.

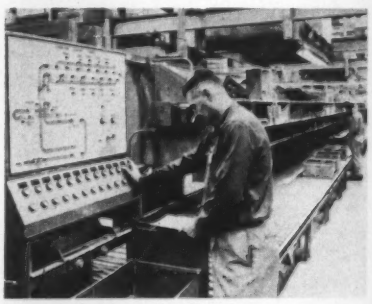
Two major handling systems are in use at the new distribution house. One system is used to transport parts and equipment through a shop area where telephone equipment is rebuilt. The second system is used in the warehouse area to increase the efficiency of order picking.

Rebuilding of telephone equipment is a cost-saving operation performed in most Western Electric distribution houses. Items such as used desk telephones are completely disassembled, worn parts are replaced, handset and plastic covers are refinished, and the unit reassembled to be put back in service. In the equipment rebuilding shop, two belt conveyors, tiered one above the other and running in opposite directions, carry work in aluminum trays along the full length of the shop. Spur lines, also tiered two-high, branch off from the belt conveyors to various work stations. Aluminum trays containing used equipment are routed to work stations by means of preset pins which strike deflectors along the main conveyor and are switched onto appropriate gravity roller spurs.

After each rebuilding operation has been completed, operators place the trays on either the upper or lower level of the spur, according to the location of the next operation in the process. Trays then roll back onto the belt conveyor for transportation to the proper spur, determined by the preset pins. After reassembly of the unit, the conveyor transports the trays to storage and shipping areas.

The conveying system in the order picking area also uses a pin-deflector method of shunting trays to the picking stations. The order is collected in a hamper placed on a special carrier by electrically-operated pneumatic equipment. If more than one hamper is required for a given order, additional units are placed on a conveyor behind the carrier and go to the same destination. Before order picking begins, a dispatcher reviews the order and sets tabs on the carrier for appropriate pickup stations. The carrier and hamper travel through the order selecting process on a live roller conveyor line which parallels a gravity roller conveyor line. At the proper stations, the tabs on the carrier strike limit switches which cause deflectors to shunt the units onto the gravity conveyor. After

TIERED conveyor system at a distribution house of Western Electric Co. Inc. transports aluminum trays of used equipment to various work stations for complete rebuilding of telephone components. Preset pins on the trays cause the units to be switched onto spur conveyors at designated points in the rebuilding process. Inclined conveyors on the right carry trays to and from receiving, storage, and shipping areas.



DISPATCHER on the pick-order line reviews order and sets carrier tabs for automatic discharge of hamper at proper picking stations. Control panel indicates activity along entire system. Carriers travel down inner conveyor until tabs cause them to be shunted to outer conveyor.

all items have been placed in the hamper at the particular station, a slight push moves the carrier and hamper back onto the live roller conveyor for transportation to the next programmed station.

Following order picking, carriers are returned to the dispatcher for re-use by conveyor. Articles are checked against the written order and then forwarded to the packing and shipping area in the same hampers used in order picking.

Data Retrieval Machine

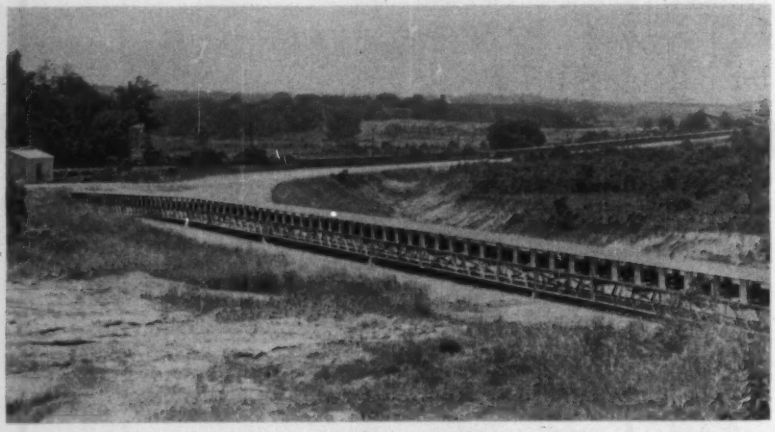
AUTOMATIC microfilm search and display machine has been developed by the Benson-Lehner Corp. The machine, known as FLIP (Film Library Instantaneous Presentation), is designed to locate and display a desired frame of 16 mm photographic film in a few seconds.

The film transport of the machine is designed to accommodate 1200 feet of 16 mm film, containing up to 72,000 frames of information. Adjacent to each frame on the film are bars representing coded binary digits identifying data shown on the film frame. Search information is entered into a keyboard of the machine, and, as the film moves through the machine, photosensitive elements scan the code bars until the correct frame is found. The machine may be used to store any type of information which can be photographed such as machine drawings, photographs, and tabular material.

High Speed Punched Card Reader Developed

JOINT PROGRAM to develop and market a new high speed punched card reader has been announced by Philco Corp. and the Uptime Corp. A prototype model of the new unit has been in full operation for more than six months at Uptime Corp. for engineering evaluation.

The data processing device reads conventional 80-column punched cards at a rate of 2000 cards per minute. It has a capacity in the feed and stacking hoppers for 4000 cards. Philco's Government and Industrial Div. will provide product engineering, manufacturing, quality control, and field testing for the new reader. The unit will be marketed by Uptime Corp. under the trade name of Speedreader 2000.



OVERLAND conveyor belt system developed by B. F. Goodrich Industrial Products Co. delivers 800 tons an hour of coal from a preparation plant of the Pittsburgh-Midway Mining Co. to barges on a river more than a mile away. Belt in the background is 2550 feet long and delivers coal from the plant to the transfer station on the left. After a right angle change of direction, belt in the foreground travels 4400 feet in a single span to carry coal to barges. Before the conveyor system was installed, trucks transported the material between the plant and the river. Belt speed is 600 feet per minute, and the belt is turned over 180 degrees at each end of system. Therefore, only the clean side of the belt is permitted to run on the top of the return idlers, preventing clogging and damaging buildup on the idlers.

Magazine Labeling Speeded By Electronic Printing System

ELECTRONIC PRINTER developed by Stromberg-Carlson, Div., General Dynamics Corp., will be used by Curtis Publishing Co. to speed up the processing of address labels for three of its consumer magazines. When compared to existing electromechanical printers, the new system of electronic printing will produce labels as much as ten times faster.

The printing system utilizes Stromberg-Carlson's Model S-C 5500 high speed electronic label printer combined with a M-60 auxiliary magnetic tape editing buffer. Subscription information will be processed by an electronic computer and recorded on magnetic tapes. The editing buffer will handle up to four magnetic tape inputs for the electronic printer. Using a Charactron shaped beam tube (which translates tape data into characters on a cathode-ray screen), and a Haloid Co. Xerox-Copyflo printer (which transcribes character images from the tube screen to paper), the electronic printer will print simultaneously on four separate rolls of paper. The electronically prepared labels will then be affixed to magazines by conventional labeling equipment. The electronic system will be capable of printing over one million address labels per 8-hour day for the *Saturday Evening Post*, *Holiday*, and *Ladies Home Journal*.

Switching Thermistor Changes Resistance on Temperature Rise

DEVELOPMENT of a new family of solid state devices that serve as tiny contactless thermal switches has been announced by the Materials Engineering Laboratories, Westinghouse Electric Corp. The new devices, called Positive Temperature Coefficient Thermistors, undergo an abrupt and substantial increase in resistance when their temperature rises to a specified point and return to normal resistance when cooled below the specified point.

The switching themistors are small ceramic discs, roughly the size of aspirin tablets, that are surfaced on opposite faces with a metallic coating. After attachment of wire leads, they are encapsulated in

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- Eliminates Inaccurate "Spot Check" Counting!
  Continuous integration assures highest precision.
- Eliminates Cam and Linkage Errors!
  Unique design balances differential pressure signal directly against centrifugal force.
- Eliminates Calculations!
  Automatically extracts square root — shows totals in desired units.
- Eliminates Fire and Explosion Hazards!
  Simple, all-pneumatic operation requires no electric motors, wires, or contacts.

FOXBORO
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Now you can integrate all your plant flow measurements, including oxygen . . . *continuously* . . . with new accuracy . . . complete safety! The all-pneumatic Foxboro Flyball Integrator completely eliminates intermittent counting and fire hazard. Its simple, force-balance operation utilizes the 3-15 psi air signal from any conventional differential-pressure flow transmitter. This signal is *continuously* balanced against the "flyball" force of the instrument's pneumatically-driven turbine. The square root function is automatically extracted . . . you read flow totals *directly*.

The Flyball Integrator mounts at the point of measurement or on a panel hundreds of feet away. Response and accuracy are completely unaffected by ambient temperature changes or pressure changes in turbine air supply. Ideal solution to all plant fluids accounting and in-process inventory checking. Write for complete details. The Foxboro Company, 121 Norfolk St., Foxboro, Mass.

FIRST IN FLOW

Circle 659 on Page 129

an epoxy resin having thermal, electrical, and mechanical characteristics. By varying the composition of the ceramic discs during manufacture, it is possible to precontrol both residual resistance and temperature level at which switching occurs. For example, thermistors for motor over-temperature protection will switch at specific temperatures between 100 and 125C and will function in control circuits requiring a 17:1 ratio of maximum to residual resistance.

Westinghouse will use the new thermistors for over-temperature protection of hermetically-sealed motors in large air conditioning and refrigerating systems. Installed directly in the motor windings, the thermistors will operate a small external relay which will de-energize the motor or give a signal when overheating occurs. As the motor temperature reaches a critical point, the thermistors become high resistance circuit elements and perform the function of a switch by blocking the flow of current. When the temperature falls below the critical point, the resistance of the unit returns to a relatively low value so that the element acts as a conductor and closes the switch.

THIRD CONFERENCE ON MANUFACTURING AUTOMATION

Purdue University, Lafayette, Ind., March 23—25, 1959

CONFERENCE TOPICS AND SPEAKERS

Industrial Engineering's Role in Automation of Operations
H. H. YOUNG, Prof., Dept. of Industrial Engr., Purdue University

Cost Analysis and Machine Replacement
ROBERT A. LOWE, Managing Partner, R. A. Lowe & Co.

Manufacturing Engineering and Machine Procurement
ARMIN FRANK, Manager-Manufacturing, Vacuum Cleaner Dept., General Electric Co.

Assembling Complex Devices
GEORGE WEISER, Chief Process Engineer, Delco-Remy Div., General Motors Corp.

Handling as the Key to Automation for the Small Company
J. R. SEBASTIAN, President, Rapids-Standard Co. Inc.

Handling Products for Distribution
ALLAN HARVEY, President, Dasol Corp.

Modern Developments in Control
Dr. JOSEPH MANILDI, General Manager, Thompson-Ramo-Wooldridge Products Co.

Numerical Control of Production Machines
W. E. BRAINARD, Chief Engr., Servo Machine Tool Div., Kearney & Trecker Corp.

Automation Panel—Developing Automation for Flexibility of Output
Presented by Personnel of Endicott, N. Y. Plant, International Business Machines Corp.
1. ORGANIZATION—KEITH BENNETT, Project Engr., Test Equipment Engineering
2. STUDY OF OPERATIONS—GEORGE PHILLIP, Project Engr., Mfg. Research
3. DEVELOPING THE HARDWARE—ALFRED JOHNSON, Project Engr., Mfg. Research
4. ECONOMICS—RICHARD SEILER, Technical Ass't to Ass't Mfg. Engr.
5. DATA PROCESSING—WILLIAM ANDRUS, Mgr. of Applied Computation

LUNCHEON TOPICS AND SPEAKERS

Pioneering in Automation
WILLIAM ALDEN, President, Automation Management Inc.

Automation on the Farm
E. W. LEHMANN, Professor Emeritus, University of Illinois

Automating the Horses
O. C. LEVY, Vice President, American Totalisator Co.

As in past conferences, there will be round table discussions led by experienced men from various industries. The conference is sponsored by the School of Mechanical Engineering and the Dept. of Industrial Engineering, Purdue University, and the editors of AUTOMATION. Printed copies of the complete program are available by writing: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio, or by mailing the Inquiry Card on Page 129. Advance reservations should be sent to: Automation Conference, Div. of Adult Education, Purdue University, Lafayette, Ind.

Override Control Eliminates Remaking Machine Control Tape

MANUAL FEED RATE override that permits an operator of numerical controlled machine tools to vary cutter feed rate from that programmed on a control tape is now available as a standard feature of numerical control systems built by Industrial Controls Section, Bendix Aviation Corp.

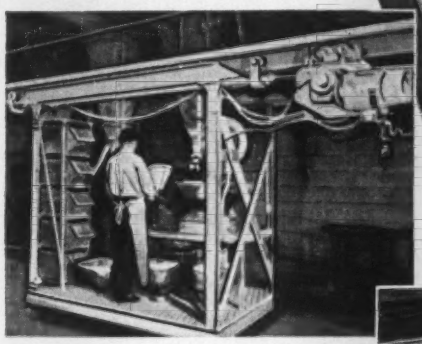
The new feature eliminates the necessity of remaking machine control tapes to provide reduced tool loading in critical areas where variables such as cutter quality, material hardness, vibration from fixture or tool, or incorreot feed rate programming cannot be taken into account. Feed rate override may be exercised at any time during the

Memo To Automaters . . .

COMPREHENSIVE program of the Third Conference On Manufacturing Automation has been designed for appeal and practical value to manufacturing engineers, production executives, and administrative managers. Mark your calendar today so that you will not pass up the opportunity to attend this outstanding event—the only conference specifically devoted to automation. Top authorities from diversified industries will discuss key topics related to the latest advances in automatic operations. Remember the dates—March 23-25, 1959—and make your reservations early.

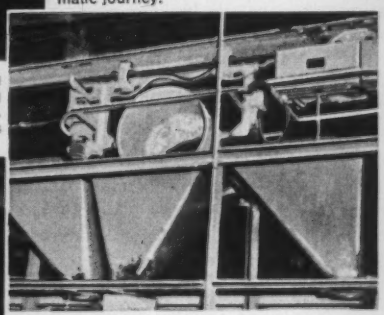
Automation in Action!

Louden Selectomatic Dispatch

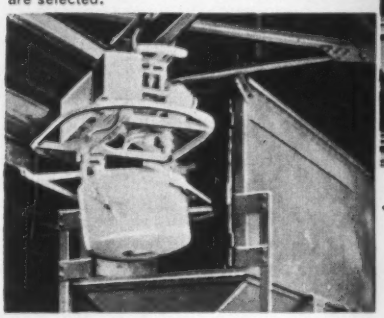


1 A Mixing Operator loads a carrier after electrically calling it on the control panel. After loading, he will select on the panel the carrier's destination and start its automatic journey.

2 A Mixing Operator rides a Louden Weighing Lorry selecting the grades of grits according to type of grinding wheel to be manufactured. Similarly, the various grades of bonding agents are selected.



3 Completely unattended, the Louden Selectomatic Carrier stops at a designated press hopper and dumps the mix.



4 After automatically dumping, the carrier proceeds to the cleaning station; opens and shuts doors, starts and stops an air cleaning jet which thoroughly cleans the bucket.

Get the latest information on the best in modern materials handling systems. Write today for your copy of "Economical Material Handling", a 52-page book full of how-to-do-it ideas. If you are interested in automation, ask for the new book on Louden Automatic Dispatch, "Automatic Materials Handling". With either you will receive the latest information on Louden Shok-Pruf Electrification, new safety in power for cranes and monorail systems.

Automation always brings its greatest gains by the waste it eliminates in *handling*. It saves time and it saves labor; uses men for their brains rather than their brawn, makes materials handling an aid to their skills rather than an unpleasant handicap. This is the way Louden automatic materials handling serves the world's most modern bonded abrasives plant of the Carborundum Company that was completed recently in Logan, Ohio.

This new Carborundum plant was *designed* to gain the benefits of automation with a Louden Selectomatic Dispatch System. Materials storage is on the third floor, materials mixing is on the second floor, molding of the mixed materials is on the first floor, with interfloor transfer of materials by gravity. The Louden equipment operates in the mixing and molding departments.

Mixing operators on Louden Weighing Lorries move from spout to spout drawing grits and bonding materials from the storage above and mix these according to formulae for the grinding wheels to be manufactured. Each mix is placed in a hopper at a loading station. Then, when a press on the floor below is ready for a mix, the touch of a Louden Selectomatic control button *automatically* brings an empty carrier into position under the proper loading station, directs the carrier to the hopper of the proper press, dumps the mix, sends the carrier to an automatic cleaning station, and then returns it to the "empty" line to await another call. Six such Louden Selectomatic Carriers operate over more than 1,700 feet of Louden Monorail to serve the many presses in this molding department.

When you are planning new production facilities or the extension on modernization of your present facilities, discuss your plans or problems with Louden engineers. No company in materials handling engineering has the years of experience, the array of equipment or the record of accomplishment Louden can demonstrate. Write or wire today.

Louden

MONORAIL & CRANES

THE LOUDEN MACHINERY COMPANY
9601 Broadway, Fairfield, Iowa
A Subsidiary of Mechanical Handling Systems Inc.

SINCE 1867 . . . THE FIRST NAME IN MATERIALS HANDLING

Circle 660 on Page 129

machining cycle without affecting the accuracy of the finished part. A dial control is provided on the numerical control operator's panel which permits the cutter feed rate to be reduced from the programmed rate of 100 per cent down to as little as 20 per cent of the programmed rate.

Compressor Control System Signals Abnormal Operation

AUTOMATIC COMPRESSOR control system has been developed by Ingersoll-Rand Co. to continuously supervise and check compressor operation and to initiate warnings if malfunctions occur. The system is available only on compressors manufactured by the company and can be supplied for machines ranging in size from 100 to 7500 hp.

The control system monitors the discharge pressure and temperature of the compressed air, lubricating oil pressure and temperature, supply or failure of cooling water, and cylinder lubricator operation. It checks the intercooler condensate level and provides protection against mechanical failure of running parts such as leaking or broken valves.

Abnormal compressor operation is indicated by both audible and visible alarm signals. If the alarm signals are ignored or forgotten, the compressor is automatically shut down when the abnormal condition reaches a danger point. When oil pressure fails or vibration occurs, the compressor is stopped at once without advance warning signals.

Warning and shutdown circuits lock-in and continue to operate until a reset pushbutton is operated. If the abnormal condition corrects itself, the reset button still must be operated to turn off the indicators or start the compressor.

ELECTROSTATIC hand spray gun developed by Ransburg Electro-Coating Corp. uses an atomizing bell incorporated in a lightweight holder. Special voltage pack is connected to the gun with flexible cable, creating an electrostatic field between atomizing bell and article to be coated. "Wrap-around" nature of spray can coat all sides of an article from one operator position with large savings in coating material and application time.

Design Data on Silicon Controlled Rectifier Available

AVAILABLE from General Electric Co. is a 17-page booklet entitled "Application Notes For ZJ-39A Silicon Controlled Rectifier." The booklet covers general circuit design considerations, firing circuit design, and typical applications for the newly developed controlled rectifier.

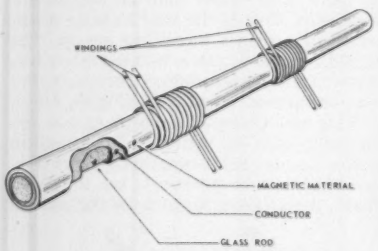
The silicon controlled rectifier is a 3-lead semiconductor which behaves similar to a gas thyratron. It is basically a rectifier which is modified to block forward direction until a small pulse of current is injected into the gate terminal. After this, the unit assumes the forward characteristic of a conventional rectifier.

Copies of the booklet may be obtained by writing to General Electric Co., Semiconductor Products Dept., Syracuse, N. Y., and asking for publication number ECG-327.

New Type Switching & Storage Element Developed For Computers

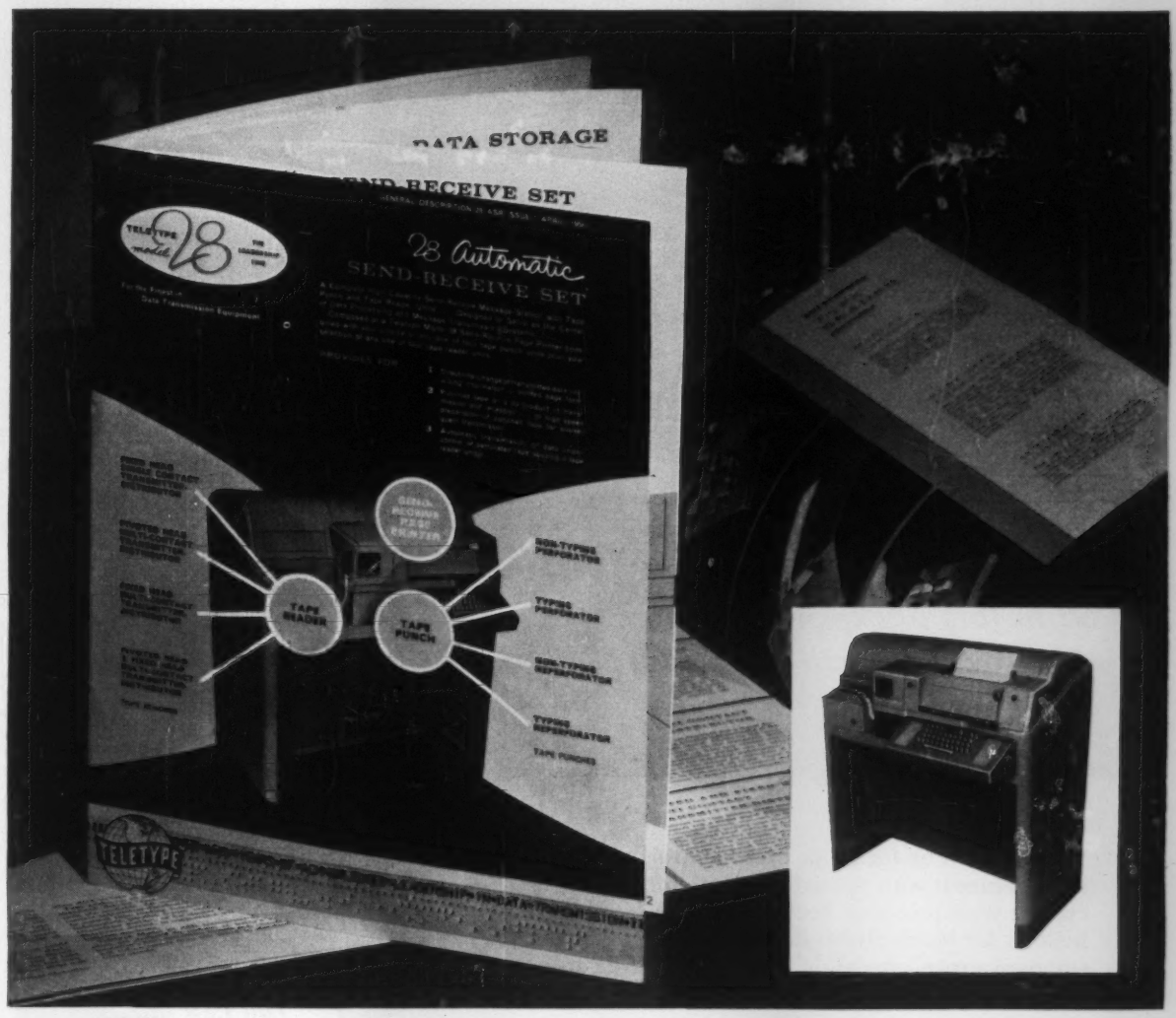
TINY MAGNETIC device the size of an ordinary straight pin promises to increase the operating speed of future electronic computers 10 to 20 times. The device, a glass rod with a magnetic coating, serves as both a switching and information storage element, and was developed under the direction of **D. A. Meier**, research scientist at the Electronics Div., National Cash Register Co.

The rod is about 0.015 inch in diameter and is given a magnetic coating by an electrochemical process. Small windings of wire around the rod store information. These windings are placed on the rod in a solenoid-like manner with successive windings superimposed. It is possible to wind ten bit-positions per linear inch along the rod without mutual interference. Depending upon the storage capacity desired, the length of the rod can be varied. At present, packing density is 1000 bits per cubic inch, although this is not an electrical limit. A rod memory system the size of a cigarette package could store 8000 bits of information. Improved techniques in solenoid windings will make greater compactness possible.



A single magnetic element for a coincident current memory requiring two inputs, an inhibit winding, and a sense winding would consist of four separate single-layer concentric solenoids over the rod. Memory matrices, each consisting of many solenoids, can be stacked and simultaneously threaded with the rod. Top speed of the device is yet unknown. However, research models have exhibited switching speeds as fast as 4 millimicroseconds.

The new component is expected to find many applications in the field of commercial data processing systems. Since the rod can serve both as a logical switch and a storage element, its use will permit a reduction in the number of semiconductors required in a computer. While some transistors will still be required, all switching will be performed by the rods themselves. As a result, the number of active components in a computer can be reduced and reliability improved.



FREE– Teletype booklet ...details new 28 ASR

Contents—Includes information on:

- Automatic communications
- New transmission speed
- Tape punching
- Tape reading
- By-product tapes
- Printing on tape
- Printing on forms
- Data processing
- Data transmission
- Data storage
- Aids to IDP
- "Robot brain"
- Reducing "clerical lag"
- Etc.

This 16-page booklet describes the new Teletype Model 28 Automatic Send-Receive Set.

The Model 28 ASR is a "packaged" set—a single, compact console with a complete array of facilities—to serve as a center for your communication, data processing, paperwork simplification and automation systems. Operates at 100 WPM.

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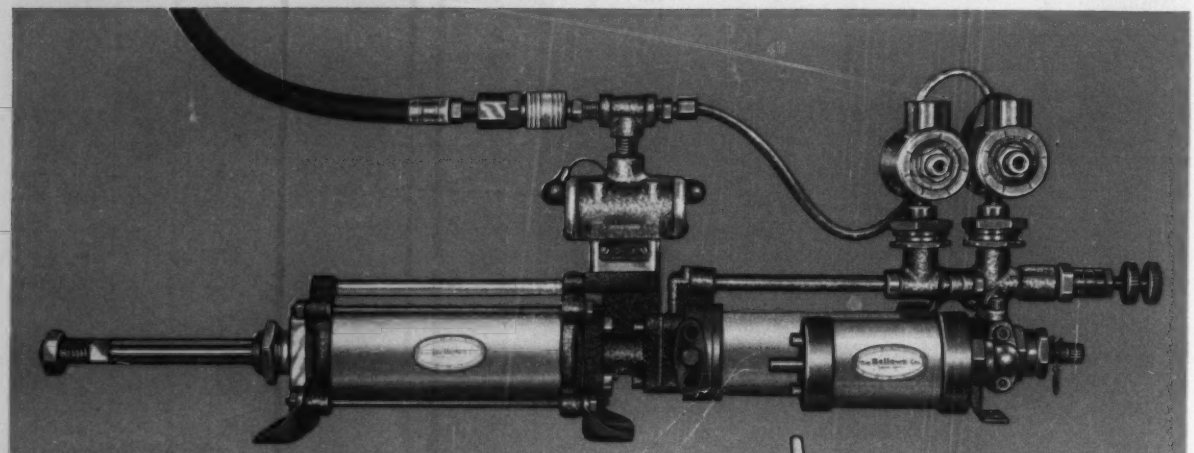
HOW TO "INCH" AN AIR CYLINDER



With this packaged Bellows Air Motor-Hydro-Check Air Cylinder power unit you can do these things:

YOU CAN STOP THE PISTON ROD TRAVEL AT ANY POINT, OR AT AS MANY POINTS AS YOU WISH

YOU CAN "INCH" IT ALONG JUST AS WITH AN ELECTRIC DRIVE

YOU CAN CHANGE THE SPEED OF THE PISTON ROD TRAVEL FROM FAST TO SLOW AND BACK

You can set it up for single cycle control or synchronize it with related elements for repeat cycling with precision accuracy. This Bellows Air Motor-Hydro-Check unit is available in standard stroke lengths up to 18" and in five bore sizes: 1¼", 1¾", 2½", 3⅝", and 4½".

Not all pneumatic applications require the range of control provided in this Bellows unit, of course. But, regardless of the type of control you require, you can obtain it in Bellows Air Motors, and usually in the form of one compact, complete, packaged unit — simple to install — doubly simple to control.

THESE BULLETINS CONTAIN THE STORY

Bulletins BM-25 and HC-602 give full details on Bellows Air Motors and Hydro-Checks and the Bellows System of Air Control. There's no charge. Write Dept. AU-159, The Bellows Co., Akron 9, Ohio. In Canada, Bellows Pneumatic Devices of Canada, Ltd., Toronto 18, Ontario.

The Bellows Co.

DIVISION INTERNATIONAL BASIC ECONOMY CORPORATION

AKRON 9, OHIO

1125-B

AUTOMATION

SURVEY REPORT AND

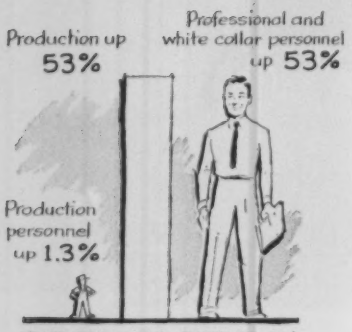
AUTOMATION FORECAST

By January 1959, automation, the technology, has become basic to American industrial operation. Strong forces are pushing industry toward increased utilization of automation and in the words of James E. Trainer, executive vice president of the Firestone Tire & Rubber Co.:

"One of the most compelling of these forces is the life-or-death necessity for this country to stay out in front in the international race for technological and scientific supremacy. This fact is so obvious that I cannot imagine anyone denying it . . . One is a projection based on the known improvement in our living standard. Another is a projection of the increase in population. Further is a calculation, based on these projections, made in terms of the output of goods and services that will be needed at various times in the future."

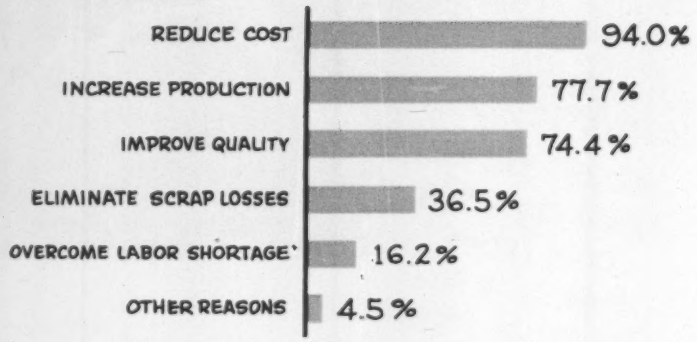
By 1975 present population of about 175 million will have increased anywhere from 41 to 69 million, according to latest

WHY INDUSTRY LOOKS TO MORE AUTOMATIC MANUFACTURING AND DATA PROCESSING FACILITIES



TYPICAL JOB TREND IN AUTOMATED PLANTS

As Reported



POPULATION INCREASE TO 244 MILLION BY 1975

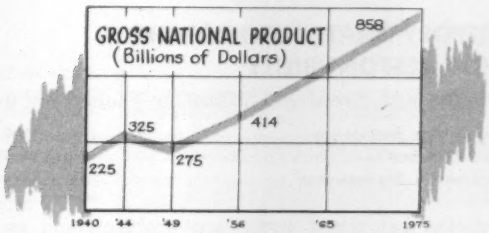
Bureau of Census forecasts. Significantly, however, greatest population growth will be in young adults and the aged. The number of Americans in the main working age group, 25 to 44 years old, will remain nearly static during the next ten to fifteen years. The young adult and college group, aged 18 to 24, will reach 25 million by 1970.

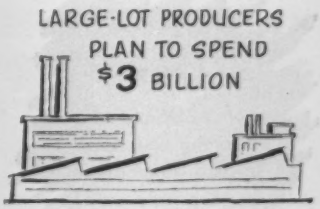
The expanding market demand created by this growth will result in a continually rising gross national product. By 1975 Department of Commerce forecasts indicate that the GNP will almost double to a total of $858 billion. A 100 per cent increase in output will be demanded from a total working population roughly 30 per cent greater than today's.

To serve this growing need, automation technology can be utilized effectively. Nevertheless, still other forces create pressure for more automated manufacturing operations: 1. Need to reduce costs to expand markets. 2. Challenge to improve product quality and uniformity. 3. Necessity to meet competition. 4. Constantly expanding horizons of technical and scientific knowledge.

As a result of the complex effects of these forces, manufacturing management has found in automation a practical answer to survival. A typical manufacturer's comment illustrates this fact:

"It was decided that the ultimate objective had to be a fully automatic integrated product-controlled production line . . . We are convinced that the principles of automation are applicable to every phase of industry and that long-range financial stability justifies the initial development time and cost required."

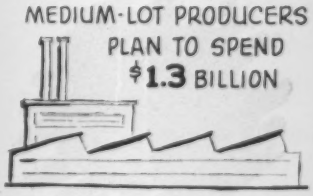




Thoughtful and considered conclusions such as these on the part of modern plant management and manufacturing engineering executives, in a manner of speaking, describe the temper and trend of the times. Careful studies of manufacturing problems, business economics, and the demands made by new products have led inexorably in the direction of more automatic operations; toward fuller development and realization of the fundamental advantages offered by automation technology.

▶ Improved Operations

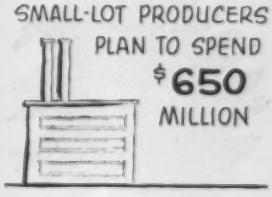
Authorities in the field recognize that automation holds continuing promise for improved operations in terms of costs, quality, safety, and reliability regardless of the manufacturing area. Their contention is that fulfillment lies not in theories or definitions but in applying available equipment and technology. Proved techniques available and being used today all add up to a firm conclusion that delays in applying automation will become more and more costly in the long run.



Of interest today are several important questions. What is the present status of automatic operations in industry? What is the extent of automation engineering in industry? What important new responsibilities have been created? What are the new influences in this changing industrial scene?

To answer these and other pertinent questions AUTOMATION's editors have conducted an extensive survey of manufacturing operations. Highlights of this study are presented in this Survey Report and Forecast. The results offer a new insight into today's trends. The broad experience of the editorial staff of AUTOMATION and a study of survey provides the base for an Automation Forecast. Tomorrow's trends are implicit in the results.

▶ A Keystone



No question, the rise of automation technology in industry has created changes, but change is inherent in the American scene. With changes, automation has become a keystone in the imposing arch of manufacturing engineering and basic to all future manufacturing operations. Accompanying it also is its significant influence on demand for engineers, scientists, technicians, and other skilled personnel. It holds the most potent challenge for the rapidly rising level of education today and tomorrow. It offers the practical answer to continuing our gradually advancing living standards and economic well being.

17.8%
of 2295 plants reporting now have special automation groups

5.2%
plan more for 1959

81.7%
of equipment builders report buyers ask for automatic devices and equipment

52.8% REPORT THAT AUTOMATION IS A JOINT RESPONSIBILITY

Responsibility and direction is lodged in 3 functional groups:

Manufacturing Engineering **59.4%**
Production Executive **24.4%**
Administrative Management **15.0%**

Automation has raised many new problems and as a result new responsibilities have been created, the most important of which are now found in the new function of manufacturing engineering. Direction of automation is largely a group activity, some committees comprising as many as twelve individuals from the foregoing categories.

PLANTS HAVING SPECIAL AUTOMATION GROUPS

(% of Plants Reporting)

SIC	Industries	% Now Have	% Plan for 1959
20	Food products	6.0	4.7
21	Tobacco	—	10.0
22	Textiles	7.3	2.4
23	Apparel and fabrics	12.5	12.5
24	Lumber and wood	6.1	6.1
25	Furniture and fixtures	14.8	3.7
26	Paper	10.7	1.2
27	Printing and publishing	12.1	6.1
28	Chemicals	20.7	3.7
29	Petroleum	33.3	2.0
30	Rubber products	12.5	9.4
31	Leather products	16.7	5.6
32	Stone, clay and glass	8.9	2.4
33	Primary metals	11.4	2.9
34	Fabricated metals	10.3	8.7
35	Machinery (except electrical)	15.8	4.5
36	Electrical machinery	28.4	5.2
37	Transportation	25.5	8.2
38	Instruments	27.9	3.3
39	Misc. Mfg.	20.7	1.7
8911	Engineering services	33.5	9.5

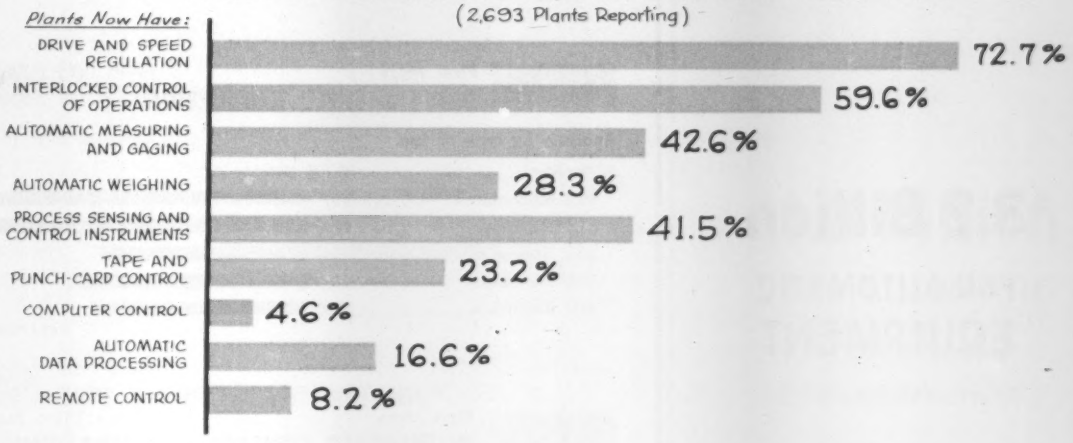
WHO ENGINEERS THE EQUIPMENT?

86.4% Engineered by User
63.3% Engineered by Equipment Builders
27.8% Engineered by Engineering Specialists

Over-all engineering of automated manufacturing systems must of necessity be carried out largely by the particular manufacturer. Once the system is evolved, the equipment builders and engineering specialists are called on for detail developments. However, 28.8% of the respondents indicated they do all engineering of equipment with no recourse to outside assistance. Another 8.1% indicated exclusive use of equipment builders and 3% use engineering specialists.

TYPES OF AUTOMATIC EQUIPMENT AND CONTROLS

(2,693 Plants Reporting)



OPERATIONS THEY PLAN TO MAKE MORE AUTOMATIC IN 1959

(1,675 Plants reporting)

% Now Used	Operation	% Planned for 1959
26.0	Assembly	17.9
6.9	Calendering, sheeting	2.5
6.3	Casting, forging, rolling	3.6
20.0	Cutting, shearing, forming	9.3
17.4	Data processing	8.8
23.6	Finishing, painting, coating, plating	10.4
48.0	Handling, conveying, transferring	26.2
31.8	Heating, baking, heat treating	10.9
15.5	Inspection	12.0
19.8	Machine tools	9.8
11.0	Machine tools, automatic load & unload	7.6
2.4	Machine tools, tape and card control	3.9
9.3	Molding, extruding	5.5
27.8	Packaging, bundling, filling	17.2
30.2	Processing	15.9
14.0	Stamping, drawing	8.1
6.8	Stock control, warehousing	5.7
10.7	Storage, feeding, sorting	7.3
16.6	Testing	10.3
18.9	Washing, cleaning, conditioning	9.2
5.4	Weaving, sewing, stitching	2.5
23.0	Weighing, mixing, blending	12.0
12.1	Welding, riveting, fastening	7.8
11.3	Winding, coiling	6.0
5.3	Other	2.9

94.8%

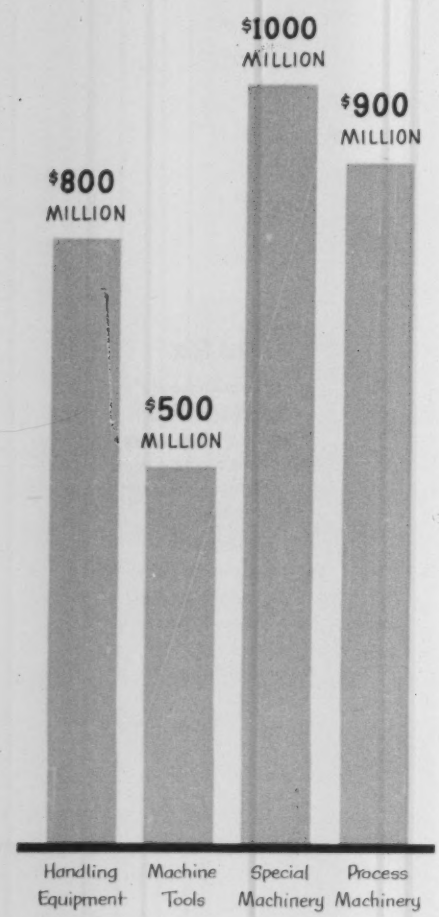
of equipment builders seek to reduce customers processing costs with automatic devices and equipment

TYPES OF AUTOMATIC EQUIPMENT AND CONTROLS THEY PLAN TO BUY

(2693 PLANTS REPORTING)

$3.2 Billion FOR AUTOMATIC EQUIPMENT

(Forecast for 1959)



40.7% Plan More — (72.7 Now Have)

DRIVE & SPEED REGULATION

Analysis by type or use:

% Now Have		% Plan More
86.2	Mechanical	41.7
84.6	Electrical	43.4
50.5	Hydraulic	25.4
52.8	Pneumatic	28.4
44.1	Electronic	26.6

1,993 Plants Reporting

33.2% Plan More — (59.6 Now Have)

INTERLOCKED CONTROL OF OPERATIONS

Analysis by type or use:

% Now Have		% Plan More
66.8	Mechanical	34.1
87.7	Electrical	47.0
31.2	Hydraulic	18.4
43.9	Pneumatic	25.5
39.2	Electronic	26.5

1,652 Plants Reporting

25.0% Plan More — (42.6 Now Have)

AUTOMATIC MEASURING & GAGING

Analysis by type or use:

% Now Have		% Plan More
69.2	Mechanical	33.2
56.2	Electrical	33.8
33.9	Pneumatic	21.2
41.1	Electronic	32.6

1,252 Plants Reporting

15.8% Plan More — (28.3 Now Have)

AUTOMATIC WEIGHING

Analysis by type or use:

% Now Have		% Plan More
76.5	Mechanical	34.7
36.5	Electrical	26.7
10.6	Pneumatic	9.1
23.5	Electronic	22.3

860 Plants Reporting

24.2% Plan More (41.5 Now Have)
PROCESS SENSING & CONTROL INSTRUMENTS

Analysis by type or use:

% Now Have		% Plan More
53.6	Pneumatic	28.8
76.6	Electrical	42.4
59.2	Electronic	38.4
16.0	Nuclear & X-ray	11.6

1,178 Plants Reporting

14.8% Plan More (23.2 Now Have)
TAPE & PUNCH-CARD CONTROL

Analysis by type or use:

% Now Have		% Plan More
13.9	Production machines	20.4
9.0	Process equipment	13.4
79.8	Office machines	43.9

719 Plants Reporting

4.4% Plan More (4.6 Now Have)
COMPUTER CONTROL

Analysis by type or use:

% Now Have		% Plan More
42.6	Production process	46.3
9.6	Pilot plant	12.8
33.5	Machines	36.7

188 Plants Reporting

12.2% Plan More (16.6 Now Have)
AUTOMATIC DATA PROCESSING

Analysis by type or use:

% Now Have		% Plan More
82.0	Orders, inventories, operations	60.7

544 Plants Reporting

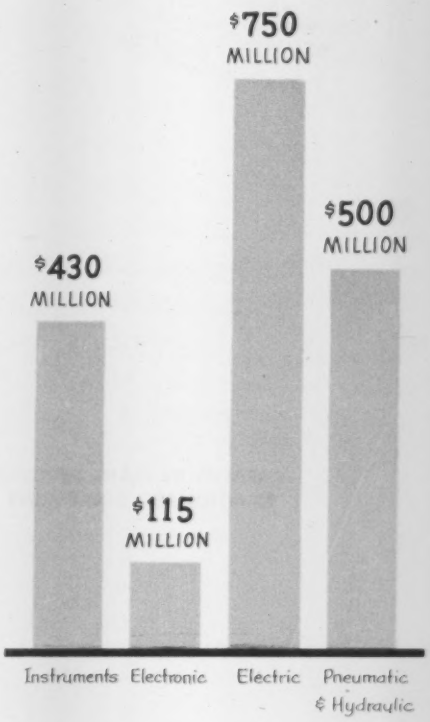
6.1% Plan More (8.2 Now Have)
REMOTE CONTROL

Analysis by type or use:

% Now Have		% Plan More
57.2	Telemetering	40.6
39.2	Data logging	35.7

283 Plants Reporting

$1.8 Billion
FOR AUTOMATIC
CONTROLS
(Forecast for 1959)



EQUIPMENT BUILDERS

EQUIPMENT BUILDERS REPORT:

WHO DEVELOPS MACHINE AND PROCESS CONTROL SYSTEMS?

Do-it-themselves...82.9%
Control builders.....24.5%
Engineering specialists.....21.2%

EQUIPMENT BUILDERS REPORT:

WHO DEVELOPS FEEDING AND HANDLING DEVICES?

Do-it-themselves...80.8%
Feeder builders.....27.0%
Handling specialists 10.7%
Engineering specialists.....17.7%

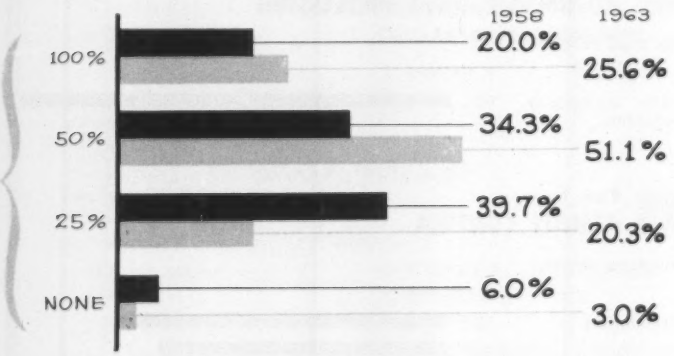
EQUIPMENT DESIGN AND BUILD ACTIVITY

	% of Companies Reporting
Assembly	41.7
Calendering, sheeting	8.3
Casting, forging, rolling	8.3
Cutting, shearing and forming	22.4
Data processing	13.5
Finishing, painting, coating & plating	15.8
Handling, conveying, transferring	53.9
Heating, baking and heat treating	17.8
Inspection	26.0
Machine tools	32.6
Machine tools, automatic loading & unloading	32.2
Machine tools, tape or card control	11.1
Molding, extruding	9.2
Packaging, bundling, filling	28.0
Processing	30.1
Stamping and drawing	20.0
Stock control, warehousing	7.6
Storage, feeding and sorting	19.4
Testing	28.2
Washing, cleaning, conditioning	13.9
Weaving, sewing, stitching	5.1
Weighing, mixing and blending	18.5
Welding, riveting and fastening	18.5
Winding, coiling	15.1
Other	12.5

54.3% REPORT OVER HALF THEIR BUSINESSS IS FOR AUTOMATIC EQUIPMENT

Demand for more automatic operations throughout industry has increased the volume of business for builders of automatic equipment. This chart shows the present and anticipated portion of their business in this category. Some 66% of the builders indicate business has been increasing over former years.

CAPACITY OF PLANT DEVOTED TO AUTOMATIC EQUIPMENT



By 1963 the number of production machinery builders doing more than half of their business in automatic equipment will rise to 76.7%, from its present level of 54.3%.

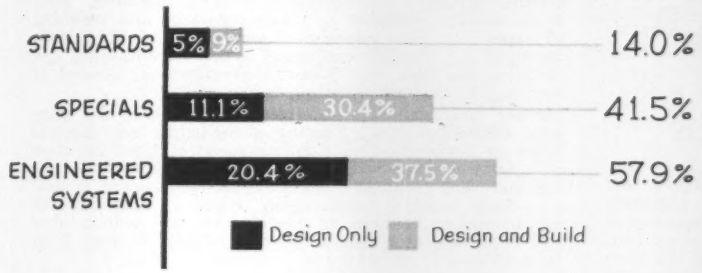
COMPONENT BUILDERS

TREND IS TOWARD SYSTEMS

Responding to questions regarding their primary categories of operations, designers and builders of components for automatic equipment strongly indicate the present trend is more toward engineered drive and control systems. Because of the highly complex

63.4%
of automatic equipment manufacturers indicate users influence selection of primary drives, controls and other purchased parts

SYSTEM TREND REPORTED BY DESIGNERS AND BUILDERS



nature of automatic control systems for automated manufacturing equipment, there is also a strong trend to special components. Much of this influence can be attributed to the highly specialized one-of-a-kind nature of automatic production machinery and the necessary dependence on drive and control specialists for engineering of the integrated system.

COMPONENT DESIGN AND BUILD ACTIVITY

	% of Companies Reporting
Computer controls	14.2
Communications equipment	12.9
Dimensional controls	18.6
Electrical controls	51.8
Electronic controls	42.8
Hydraulic components	40.8
Instrument controls	30.1
Lubrication systems	15.2
Mechanical controls	49.3
Motor controls	23.9
Motors	6.9
Nuclear & X-ray controls	6.5
Numerical controls	10.3
Pneumatic components	27.8
Process analyzers	6.5
Process control equipment	25.7
Program controls	19.9
Test & inspection devices	33.2
Visual & audible devices	15.0
Weight controls	16.3

67.7%
of component builders indicate users influence selection of individual system components

SPECIFIC AUTOMATION PLANS

In this study AUTOMATION asked what manufacturing facilities would be automated in the next five years and what new devices were being developed particularly for automation needs. The intensely interesting and significant comments in reply to these two questions are listed by SIC groups in the following. Breadth of development and long-range trends in manufacturing automation are implicit in these verbatim comments.

SIC 20—FOOD AND KINDRED PRODUCTS

Equipment

Material handling from manufacturing to inventory and from inventory to shipping . . . Warehousing, packaging and cartoning, bulk loading . . . Pneumatic handling of most bulk raw materials . . . Most of the in plant handling of products during production as well as of the process equipment . . . Bag packing . . . More packaging and conveying, weighing and packaging . . . Partial warehousing . . .

Handling of bottles and cases full and empty . . . Handling, unloading, filtering of beverages . . . Bulk grain unloading, package cleaning, process equipment cleaning, inspection and testing, warehousing and shipping . . . Keg handling, case handling of beer . . . Operation of bottling line equipment, operation of case handling equipment, operation of barrel handling equipment . . . Bulk material handling dry and liquid. Bulk loading of feeds . . . Milk handling . . . Partial automation of shipping facilities for milk . . . Cleaning of cases and cartons, palletizing of cases . . . Automatic scaling . . . Warehouses and stockrooms . . .

Ingredient weighing, checking . . . Pork cutting operation, hog grading operation . . . Killing lines of cattle and hogs . . . Packaging and filling ice cream . . . Coding ice cream . . . Loading and unloading fruit bins . . . Blending single strength and concentrated juices . . . Can conveying . . . Flour dryer, bake shop, mixing, weighing case handling, car loading, unloading . . . Handling of production between moulder, panners and wrapping machines for baked goods . . . Bread production to and from ovens . . . Sugar drying centrifugal . . . Sugar liquor treatment, storage packing and handling of the product . . . Manufacturing of candy (mixing, cooking, temperature control, forming) handling equipment (palletization and de-palletization) . . . Cocoa bean handling and various steps in process storage and handling raw material and finished goods . . . Raw and refined centrifugals for sugar, tank and pan controls, process controls . . . Bread production to and from ovens . . .

Automatic mixing and batching equipment . . . Formulization of feeds . . . Inspection and receiving equipment . . . Processing and handling . . . Unit product processes . . . Blending operations . . . More process control . . .

Order and planning, inventory control . . . Power plant, coal handling equipment . . . Specialty packing, automatic feeding, quality control, automatic specialty weighing, air control and handling . . . Watchman services . . .

SIC 21—TOBACCO MANUFACTURERS

Equipment

Certain processing operations, drying of leaf tobacco, conveying, packaging, weighing, inspection . . .

SIC 22—TEXTILE MILL PRODUCTS

Equipment

Dyeing, drying . . . Automatic winding machines, automatic package machines . . . Lap conveying and weighing of yarns . . . Also rejecting of textiles . . . Sewing, yarn handling . . . Possibly continuous dyeing . . . Knitting and finishing machines . . . Weaving partially . . . Control of setting of fabric (heat set nylon, dacron, etc.)

Material handling . . . Movement of cartons in the shipping department . . . Printing identification on customer boxes or packages . . . Continuous carpet finishing lines . . . Control water and industrial waste in processing, dyeing and yarn finishing . . . Tufted carpet pattern control . . . Stock blending (wool, rayon, nylon) . . . As many of the production facilities as possible that will reduce labor and improve quality . . . Automation within the plant must be economically advantageous and must be efficient . . . Data processing may be completely automated . . .

SIC 23—APPAREL AND ALLIED PRODUCTS

Equipment

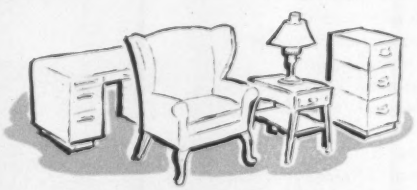
Distribution, packaging, order picking of clothing . . . Assembly of belts, buckles, braces, jewelry . . . Some automation in raw materials and finished goods handling . . . General ledger accounting . . .

SIC 24—LUMBER AND WOOD PRODUCTS

Equipment

Sorting of lumber on green chain . . . Setting of logs on carriage for sawing . . . Handling of cross ties . . . Car unloading . . . Preparation of lumber for kilns . . . Drum assembly . . . Some inspection and gauging processes . . . Many conveying and handling arrangements . . . Finishing . . .

Wrapping, painting, pressing, trimming, sanding, packing . . . Lumber manufacturing will probably never be completely automated due to the nature of the product . . .



SIC 25—FURNITURE AND FIXTURES

Equipment

Automatic graining, drying, gluing (electronic) . . . Metal stamping and wire forming. Mitering and spline cutting in woodworking . . . Frame assembly, stock cutting of doors, door sizing, veneer joining and splicing, press loading . . .

Tube bending, welding . . . Roller assembly of window shades, packaging shades . . . Assembly and fitting of furniture . . . Pressing plastics . . . Material handling, conveying, transferring . . . Many hand assemblies . . .

SIC 26—PAPER AND ALLIED PRODUCTS

Equipment

Entire wet end of paper machine . . . Binder making . . . Shipping case sealing, bindery gathering of book sheets . . . Some printing and fabricating techniques will be tied together . . . Tablet making, loose leaf fillers . . . Cartons from web to finished and packed product . . . Various operations that take a roll of paper and cannot connect to a saleable product (paper converter) . . . Automatic control of weight and moisture of paper . . . Automatic stock preparation systems . . . Continuous pulping . . . Continuous process controls of all types used in manufacture of pulp and paper . . . Sheeters and trimmers . . . Weight control on paper machines . . . Tension control on calenders . . .

Bundling of corrugated boxes . . . Cutting, forming, covering, assembly, filling, packaging, handling, stock control, warehousing of paper specialties . . . Beta-ray basis weight control . . . Handling of paper in finishing room through inspection, trimming, and packing operations . . . Pulp production . . . Gathering book sheets . . .

In process transit of product in sack manufacturing . . . Better sensing and rejection of inferior product . . . Finishing room . . . Conveyor systems . . . Material handling systems . . . Printing, drying, automatic stripping, and waste removal . . . Data processing, information handling, production controls . . . Labeling and hauling finished products . . .

SIC 27—PRINTING AND PUBLISHING

Equipment

Newsprint handling operation . . . Bagging of comic magazines . . . Counting, stacking and trimming of pocket size books from binder . . . Stacking and bundling of newspapers . . . Press delivery stackers, stackers in bindery, binder to trimmer, wrapping machines, feed and delivery . . . Various bindery operations including inspection and handling . . . Mail room, composing room, stores department . . .

Rotary presses . . . Stitching, negative processing, trimmer ejection and feeding . . . Printing, conveyorizing, and material handling . . . Bundling . . . Metal remelting . . . Scrap collection . . . Assembly facilities and connection of assembly equipment . . .

SIC 28—CHEMICALS AND ALLIED PRODUCTS

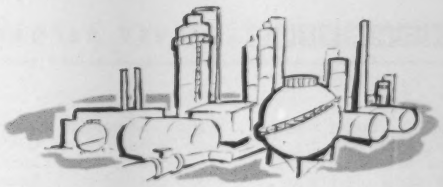
Equipment

Chemical processing . . . Chemical analysis of process streams, computer control (probably analogue and simple) of process . . . Blending and mixing operations . . . Waste disposal system . . . Solution concentrator . . . Acid plant, dryer operation . . . Dry mixing and bagging of fertilizer products . . . Most operations in the gaseous or liquid phase and controls, mainly flow and temperature . . . Synamite packaging, filling of paper and metal containers . . . Water treatment plants . . . Tank farm remote control . . . Changing from batch systems to continuous processing (nitrocellulose) . . .

Packaging, granulating, lubrication, and compressing of tablets . . . More soap and cosmetic production and packaging . . . Paint filling, labeling, and packing . . . Batch operations converted to continuous . . . Batch refining process in mills . . . Ground meal and pulp cooling equipment . . . Sack handling facilities . . . Proportioning and mixing . . .

Carbon black production in these phases: Production equipment, processing and handling . . . Some medical gas production, cylinder filling, cylinder processing and handling . . . Salt block pressing . . .

Winding operations, film windup equipment . . . Fiber baling machines, spinning, doffing, twisting of fibers . . . Filling, assembly, automatic palletizing, packaging, grinding, meal loading, blending and mixing, conveying, bulk material handling, warehousing, sewing operations . . . Various chemical processing and materials handling operations . . . All office functions such as direct mailing, inventory control . . . Data processing . . . Warehousing . . .



Boiler room controls . . . Most major installations will be automated . . . Roll sulfur and flowers of sulfur departments will be automated . . . Eventually oil well drilling will be completely automated, gradually . . . New facilities being built will be automated . . .

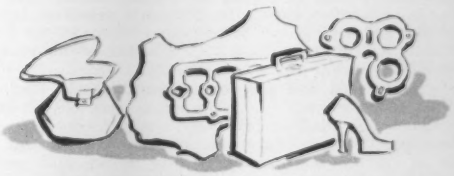
SIC 29—PRODUCTS OF PETROLEUM AND COAL

Equipment

Some automatic equipment in processing units, mainly flow and vapor pressure controls . . . Routine production or lease operations . . . Oil transfer, metering and gauging, blending and packaging, continuous processing . . . Remote tank gauging . . . Process units, gasoline blending, pipe line operations, tank farm operations . . . Moving oil to pipe line companies . . . Water flooding installations, oil handling equipment . . . Handling, blending . . . Compressor stations . . . H-F Alkalation possibly . . .

Mix batching and board processing of asphalt . . . Weighing, measuring, sheeting, calendering, and speed control . . . Some automation in production of insulation, roofing, mineral wool products, roofing felts, roofing granules . . . Ready mixed concrete batch plant . . .

Data processing, accounting . . . Long range forecasting of sales and planning of future supply system . . . Short range forecasting of sales and scheduling and control of supply systems . . .



SIC 30—RUBBER PRODUCTS

Equipment

Assembly, cutting, shearing, forming, packaging, sewing, calendering, stock processing, mixing, weighing, automatic curing . . . Conveying, handling, transferring of stock, bundling, filling, warehousing, steam power . . . Finishing operations on rubber products, extrusion and injection of plastic products. Miscellaneous subassemblies . . .

SIC 31—LEATHER AND LEATHER PRODUCTS

Equipment

Lasting room, stitching room, finishing operations, measuring, bundling, embossing, spraying and drying equipment, packing, handling . . . Steam boilers, some assembly, many machine operations . . . Handling, conveying, and transferring of upper parts of shoes in fitting department on cement flattie construction shoes . . .

SIC 32—STONE, CLAY, AND GLASS PRODUCTS

Equipment

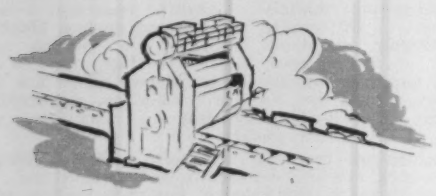
Drying, raw material blending, feed, temperature, acidity control, weighing and mixing, cutting, trimming, wheel finishing, batching raw materials, grinding, spraying, testing, decorating . . . Forming processes, finishing department, sanding, sawing, glassing, painting . . . More calendering operations . . . Slitting, winding, polishing, wave handling, mill feed . . . Extrusion operations . . . Folding, stamping facilities . . . Burning (kilns) . . . Core room operations, furnace handling systems . . . Heating and firing processing equipment and processing weighing operations . . . Sizing by dry grinding . . . Slip handling, kiln controls, batch blending, batch feeding . . . Furnace control, machining op-

erations . . . Boiler room . . . Sealing component parts glass to glass, wash and dry after polish operation . . . Cellulating and annealing furnaces . . . Certain maintenance including shop operations . . . Plant heating . . . Assembly of components . . .

Additional materials handling, more extensive packaging systems, inspection, crating, sorting, conveying to the shipping point . . . Almost all process controls, complete process cycle from data processing to inventory control through all phases of manufacturing . . . Continued elimination of hand operations where practical from a cost standpoint . . .

Components

Inspection devices, automatic feeding, transfer and positioning . . . Automated metal products manufacturing devices . . .



SIC 33—PRIMARY METAL INDUSTRIES

Equipment

Milling rolling bed repeaters, hot bed operation, additional blanking, shearing, forming, welding operations, melting operations, induction heating facilities, forging facilities, upset, slitting, plating, machining . . . Molding, weight changing, weight counting and packaging, automatic loading and unloading . . . Furnace operations, centerless grinding, inspection of size and defects . . . Some high production hot forming units . . . Plastic molding . . . Pickling, slabbing, electrolytic processes . . .

Possibly sinter feed and machine control, furnace feed and integrated power control . . . Program control on arc melting furnaces . . . Rolling mill gage control, hot strip mill, coil banding, tin plate inspection, possibly loading and unloading of process tins . . . Reversing rolling mill partial, strap slitting and packing operations partial, tool manufacture partial . . . Hot tip production . . . Automating forge and punch press operations . . . Extrusion presses, direct chill casting machines . . . Sand conditioning, molding, shakeout, machining, finishing, painting, shell core making, permanent molding and/or casting . . . Cleaning shells, continuous casting of copper and lead, spooling of solder wire . . . Heat treating . . . Plate mill . . . Machine tools . . . Annealing . . . Material handling, inspection, handling equipment, conveying, carbon handling . . . Various chemical processes . . .

Metallurgical processes such as tungsten, molybdenum, semiconductors . . . All new installations will be automatic and continuous . . . In many cases operations are pretty much automated . . . It is a matter of increasing the degree of automation . . .

Components

Machining and handling equipment . . . Wire weaving, welding, forming, twisting, drawing and coiling machinery and equipment . . . Pipe casting machines . . . Core machines . . . Mixing equipment for sand . . . Continuous rotating position indicator with ½ degree accuracy and better . . . Visual, oscilloscope, presentation of rotating mechanisms . . . Zinc slab palletizing . . . Sinter feeding . . .

SIC 34—FABRICATED METAL PRODUCTS

Equipment

Enameling, baking, stamping, drawing, assembly, finishing, blanking, forming operations, fabrication, welding, polishing, weighing, batching, washing, painting, baking, grinding, assembly, rolling, punching, gaging, machine feeds, unloading, cut-off operations, tumbling, baking, heat treating, counting, product cleaning in process . . .

Machining and finishing operations will be automated mostly by combining operations within a special machine and by handling devices between semiautomatic type machines . . . Production lines between cleaning operations and slushing operations . . . Presses, the press room, more foundry and inspection operations . . . Automation equipment to handle and transfer sheet metal stampings through presses . . .

Material handling, packaging, conveying of parts in process . . . Stock control, production control . . . Much of the can making equipment . . . Manufacture and assembly of heating cores . . . Assembly of valves and traps . . . Machining castings complete . . . Some machine tool operations . . .

Manufacturing of relays . . . Nested container forming operations, nested container coating operations, looms, welding of all wire products . . . Handling and chemical processing of thin gauge aluminum foil sheet . . . Cutting, slitting, punching, stamping, shearing of foil sheets into pieces . . . Assembly of fasteners . . .

Perforating presses, press feeds, cut-off operations, roll forming mills, sheet feeds from coils, track rolling, die casting . . . Chemical treating system . . . Blanking and shearing from coils . . . Polishing and buffing . . . Increased use of data processing . . . Collapsible tube manufacturer reports plans for being fully automated from slug to capped tube within a year . . .

Components

Heat treating devices . . . Hot forming devices . . . Stamping, rolling, and broaching of hinge parts . . . Loom parts . . . Left and right rotary solenoids AC-DC . . . Ratchet assemblies . . . DC servo units . . . Pen recording actuators . . . High temperature flow controls . . . Miniaturized valves . . . High reliability solenoids . . . Test facilities for aircraft and missiles . . . Mechanical parking garage . . . Improved press and welding automation equipment . . . Advanced analog components, precision shaft angle digitizer . . .

SIC 35—MACHINERY (except electrical)

Equipment

Stamping, assembly, machining, testing, holepunching operations, half countersinking operations, blanking operations, turning and drilling operations, coil slitting and sheeting, painting, welding, cutting, shearing, finishing, handling, casting, sawing, welding, cleaning, spray painting, degreasing, multiple drilling operations . . . Various grinding operations, lathe work, boring and drilling, perhaps milling . . . Low temperature brazing, coil assembly, broaching operations . . .

Switch assembly machines, small hydraulic presses, stamping name plates, storage feeding, molding machines, formings, finishing machines, hand screw machines to chuckers, valve finishing and assembly operations, valve machining operations, valve winding operations . . . Ticket making equipment . . . Tube cut-off conveyors to handle parts and assemble . . . Possibly gear production . . . Electronic assembly line, soldering, transformer manufacturing, stamping, winding, sheet metal welding . . . Heat transfer surface crimping lines . . . Computer subassemblies . . . Production and assembly of electrical indicating instruments . . . Bearing production . . . Base seaming . . . Gasket inserting . . . Etched circuitry . . .

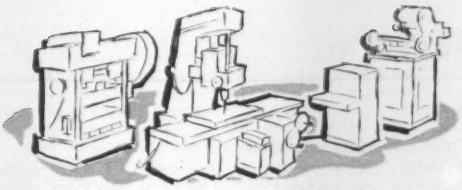
Material handling, process inspection and testing, preservation and packaging, scrap handling, boxing of packages, weighing and checking of packages . . . Staple inspection, staple packaging . . .

Data processing, office scheduling, manufacturing and inventory controls . . . Probably accounting functions to a much larger degree than at present . . . Some office machines . . .

Heliarc welding, spot welding . . . Some companies say virtually all assembly operations . . . Others say that at least 40 per cent of assembly operations will be automated . . .

One manufacturer reports building three six spindle automatic gun drilling machines, patterned after ones previously built and running successfully . . . Automating line for swaging and grinding hard iron grinding plates . . . Automating process for turning blanks from forgings for gun drilling operations above and also automatic manufacturing for drilling and tapping various bolt circles on these parts . . . Automating gray iron and hard iron foundry to some degree . . . Steady running jobs which are now done manually will be automated—each job must pay for itself in two years based on direct savings . . .

Automatic drilling and tapping of set screw holes and insertion of set screws . . . Simple welding sequences . . . Heat treating . . . Some machining operations . . . Press—



handling and welding . . . Foundry and cleaning . . . Transfer machines . . . Molding . . . Scrap handling, machine feeders . . . Selected machining operations . . . Some foundry operations . . . Painting and coating finished products . . . Turning . . . Type rolling machines . . . Gaging . . . Cleaning of parts . . . Minor subassemblies . . . Galvanizing . . . Washing . . . Shafting . . . Small parts finishing . . .

In some plants virtually the entire operation will be automated within five years . . . Increased automation will depend upon volume of business . . . In some cases operations would be called semiautomatic, that is, automatic assisting devices . . . Cost accounting, stores control, budget control . . .

Components

Material handling devices—Automatic forging handling in mechanical presses . . . Palletizing equipment . . . Automatic press unload transfer and feed machine . . . Plate handling . . . Automatic feed equipment . . . Conveyor modification . . . Automatic door operators as related to material handling equipment for lifts and elevators . . .

Bar or tube feeders . . . Bar or tube stackers . . . Bar runout tables . . . Aluminum ingot stackers . . . Self unloading sugar car insulated type . . . Positioners, orientors . . . Bottle and label handling devices . . . Conveying devices to connect our special purpose machines and eliminate handling . . . Auto-loaders and unloaders for vulcanizers . . .

Air conveying for grain, flour, and feed . . . Load and unload tracer controls . . . Magnetic handling and holding . . . Positioning tables . . . Paper handling equipment . . . Short storage units . . . Mechanical inventory controls systems and equipment for moving and transferring same . . .

Control devices—Remote controlled slab and bloom markers . . . Keyboard or punched tape operated, with scanning devices for recording on high speed printers . . . Basic standardized tooling for general operations and assembly work for positioning anywhere in the station area by hand or automatic punch card program scheduling for mass volume or for small lots down to 10 to 50 per run . . .

Scheduling for entire day by mounted tooling for no downtime during day . . . Refining of existing controls . . . Hydraulic sensing controls . . . Automatic valve controls for textile finishing machinery . . . Multiple car bank control systems . . . Block control systems for conveying equipment . . . Tape controlled indexing tables . . .

Completely automatic 180 degree and 360 degree template following controls with constant feed speed throughout cycle . . . More devices in a smaller space for controls . . . Manufacture more standard control devices . . . Turbine blade miller tape controllers . . . Temperature compensated flow control valves . . .

Electric hydraulic servo valves . . . Oil immersed solenoids for directional control valves . . . Automatic weighing and control systems for block plant, ready-mix plants, road machine paving plants . . . Remote controls for hoisting units and pumping units . . . Numerical machine tool controls . . . Control mechanisms for tape numerical control of a ram type bed type miller which meets or exceeds A.I.A. specifications . . . Numerical machine control systems . . .

Electrical controlled machinery for missile programs, motor manufacturers and automotive companies, unit heads and index tables particularly . . . Program controls . . . Specialized remote control and data transmission and processing systems for production transmission and processing of hydrocarbon fluids . . . Special sawmill dimensional control devices . . .

Equipment—Automation equipment for gear deburring and chamfering machine operations . . . New automatic plating equipment, silicon rectifiers, barrel plating equipment . . . A machine to completely assemble small motors including metering, welding, riveting, inserting, turning, gaging . . . Automatic food handling, trimming, and processing equipment . . .

Rotary air table designed to be mounted below the worktable with an extendable shaft rising through the table . . . Automatic assembly machine using double decked dials geared together . . . Parts are fed to the top dials and assembled into the lower dials and the resulting subassembly transferred to the next set of dials for further assembly operation . . . Standard stations for use on inline and rotary machines . . . Automatic transfer equipment, saws, veneer jointers, lathe loaders, plywood stackers . . . Roll crimpers . . . Stock straighteners . . .

Package green sand molding systems . . . Sheet guiding and printing . . . Final assembly testing equipment for automatic finishing of nonferrous plates to .0002 . . . Miniature automatic drilling and milling heads, all angle 0-100,000 r.p.m., 1″ stroke inline transfer machine—building block type with universal tooling and automatic load and unload for small parts not over five pounds . . .

Double end thread miller ⅞″ to 8″ capacity x 10′ . . . Concrete mixing equipment and hydraulic presses . . . Paper converting machinery . . . Multiple machine for consecutive operations . . . New line of index units both rotary and straightline . . . Indexing, inline, and dial type . . . Process equipment . . .

Testing and measuring devices—Automatic counting for citrus fruits in order to pack in bags or cartons . . . Automatic fill by weight for various products . . . Screening, dewatering, weighing . . . Metered units in the paper industry . . . Production testing systems . . . Infrared inspection device for seal testing . . . Area measuring device for tannery products . . .

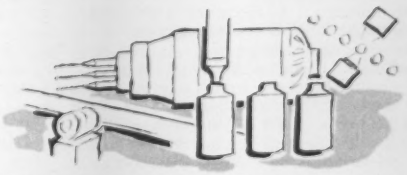
Telemetering components and systems . . . New type stretch recorder . . . Massflow metering devices for liquids and gases at pressures up to 2000 psi . . . Over and under indicators for beam scales, these have unusually long indicating ranges making it possible for the cutoff switches to handle large volume flow with maximum sensitivity . . .

Miscellaneous—Ultrareliable switches and relays using a completely different principle . . . Standard parts placing and ejection mechanisms . . . Special drying process for blood, chemicals, feathers . . . Small 1″ bore air cylinders . . . Bar length gages . . . Pumping devices . . . Variable displacement vane pump . . . Hydraulic and electrical wheel feeds . . .

Automatic clamping, releasing, or locating work holding fixtures . . . Interlocked to table to wheel slide feeds, or both . . . Larger unit mountings to carry heavier equipment . . . High impact mountings to permit straightline arrangement of machines such as adjacent hammers and grinders . . . New types of mountings which will maintain alignment of several machines in spite of foundation disturbances . . .

Automatic pin spotter . . . Plastic tipping for bookbinding . . . Lubrication feeders . . . Spindle lubricators for steel mills . . . Special automatic lubrication equipment . . . Gun drilled manifolds (hydraulic) . . . Computer auxiliary equipment . . . Automatic data recording and processing systems . . . Magnetic films for storage devices used in electronic computers . . . On line computers of many types . . .

Cost accounting computers and controls . . . Electro-hydraulic servo control systems . . . Hydraulic valves and hydraulic cylinders . . . Cash registering system, computer, guidance systems . . . Solenoid valves . . . Hydraulic and pneumatic components . . .



SIC 36—ELECTRICAL MACHINERY

Equipment

Assembly operations most frequently mentioned . . . Many manufacturers are 30% to 40% automated on assembly operations at present . . . Expect to completely automate . . . In some cases must achieve complete automation due to extremely rigid cleanliness required in manufacturing . . . Also must automate to reduce costs . . .

Annealing, molding, tapping holes, setting screws and component parts, testing, machining, finishing, painting, heat treating, parts processing, stamping, drawing, gaging, load and unload on machine tools, shearing lines . . . Coil cutting, testing, lead wire tinning, compound melting and pouring, core impregnating, welding . . . Inspection . . . Formation, posting operation, plate breaking operating and mixing . . . Machine shaft, die cast gear and shaft . . . Printing and

etching . . . Welding . . . Brazing, metal washing, soldering and molding, extruding . . .

Forming dies to be set up to run automatically . . . Special spring winder to be made to run automatically . . . Spot welding machines to be incorporated into automation . . .

Wire handling from machine to cabling . . . Blanket control assembly, blanket plug assembly, heating pad assembly . . . Tape control machine tools . . . Blanking of laminations (including stacking and weighing) . . . Small subassemblies . . . Welding of transformer core and parts painting . . . Complete TV and radio chassis assembly . . . Various tape recorder and record changer subassemblies . . . Indoor antenna rod assemblies . . . Ceramic manufacture . . . Semiconductor device manufacture . . . Plastic capacitors, tape resistors, ceramic, electronic porcelain . . . Lampmaking, testing and packing, lacquering equipment . . .

Sections of foundry and machine shop . . . Specifically automatic induction heating for brazing and soldering, drilling and tapping, automatic assembly machines, automatic processing macnines for marking, capping, packing . . .

Production lines . . . Product inspection . . . Material handling conveyances . . . Handling of finishing stock to shipping department . . . Packaging . . . Warehousing, storage, packaging . . . Stock control . . . Carton sealing, in process storing . . . Data processing, inventory control, payroll, cost accounting, bookkeeping . . .

Riveting of eyeletting operations . . . Shearing lines, manufacture of carbon deposited resistors . . . More automatic filling equipment is planned for increased production on mercury switches . . .

Automated facilities must be justified on the basis of estimated savings . . . In the communications equipment industries where the industry is going through a period of rapid change, increased automation may not be the answer due to possibility of obsolescence . . .

Components

New switching systems . . . New transducers and sensing devices . . . As manufacturer of electrical relays we are deeply involved in helping producers of automatic equipment design their switching and electrical controls . . . Automatic controls systems . . . Simplified components . . . Memory devices . . . Automatic telephone dialing device . . .

Automatic produce measurement equipment . . . Digital telemetering . . . Relays . . . New timers, speed controls . . . Differential transformers . . . Electronic relays . . . Electronic and hydraulic controls . . . Radio receivers and transmitters . . . Improved magnetic parts . . . Static control components . . . Computers, airborne servo systems . . .

Various types of low level magnetic amplifiers for use as static or solid state amplifying devices in automatic control systems . . . Instrument amplifiers . . . Circuit scanners . . . Bin level indicators . . . Installing accuRay on plate parting . . . Automatic weighing . . . Automatic cable and insulation test instruments . . . Electrical instruments . . . Electrical relays . . . Electrical resistances . . . Electrical and mechanical controllers and recorders . . .

Complete line of standard size and medium size snap action switches, toggle, pushbutton, rotary . . . Complete line of milliminiature snap action switches about 1/3 smaller than anything available today with same current carrying capacity as the subminiature line . . . Snap action relay, radically different . . . Subminiature line of hermetically sealed switches, limit switches, relays . . .

Optimizing press control devices formerly called Automex . . . Electronic controls, pneumatic controls for TV set manufacturing, including final test . . . Programming timers to control and adjust the operation of any number of units, all adjustments made on exposed dials . . . Digital computer plus the usual advancements in normal product lines, both components and complete systems . . . Telemetering systems, supervisory control systems . . .

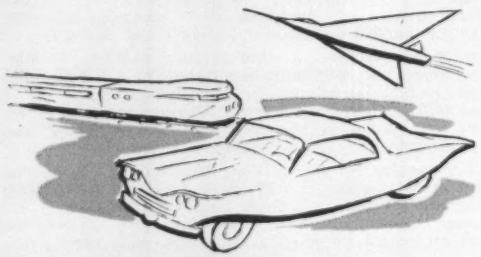
Miniature magnetic clutches, gear changers, couplings . . . Items that have longer life with less maintenance or none at all in motors and generators . . . Photo transistor sensing devices . . . Transistor and diode testers . . .

Limit switch, automation type . . . Proximity detector . . . Electronic timer . . . Electronic speed position control for VS drives . . . Hermetically sealed thermal relays by G-V controls . . . Hi-lo, dry circuit and 10 ampere, hermetically sealed relays by EMS . . . Choppers . . . Universal production analyzers . . . Automatic circuits . . . Control of magnetic pick-up of scrap material . . .

Small Sebian DC power supply (packaged) 1 to 25 amperes at 24 to 110 volt variable . . . Use of voltages for strength of electromagnets . . . Integrated automatic web alignment and color register controls for webbed multicolor printing processes . . . Automatic printers and controls for professional motion picture laboratories . . . Weditrol, positioning . . . Weditrol, contouring . . . Punched tape block reader . . . Encoder . . . Conveyor control systems . . .

Microminiature and subminiature relays . . . Reactor fuel handling systems . . . Reactor maintenance systems . . . Remotely controlled manipulators . . . Navigational and inertial missile components . . . Automatic toroid winding machine and process . . . Capacitor production . . . Component insertion . . . Board wiring . . . Welding press and conveyor lines associated with resistance welding machines . . .

Automatic lamp equipment . . . Automatic inspection . . . Automatic hydraulic straddle broach for screws . . . Automatic assembler for rubber grommets on screws . . . Automatic assembler for three part aircraft fasteners . . . Automatic drilling and tapping machine . . . Automatic resistor assembly, feeders, ceramic parts . . . Capacitor winders and assemblies . . .



SIC 37—TRANSPORTATION EQUIPMENT

Equipment

Conveyors and transfer mechanisms, some machine tools, material shaping, finishing, assembly, testing, processing and casting to a limited extent, metal fabricating machinery, assembly lines, presses . . . Welding procedures, heat treating facilities . . . Milling machines, skin mills, boring mills . . . Some forging . . . Various machining operations . . . Inspection equipment . . . Feeders . . . Tape control of machine tools . . . Parts finishing . . . Drilling and tapping machines . . .

Possibly automating water treatment plant and further automating some boiler plants . . . Cold extrusion of steel products . . . Drilling and tapping of water pump bodies, drilling and tapping water pump fan hubs . . . Automatic grinding control and gaging on piston pin . . . Centerless grinding operations . . . Trailer roof assembly . . . Drilling of wood floor for trailers . . . Fabrication, assembly, and testing of semiconductors . . . Packaging small components, assembly of mechanical components, rubber molding . . .

Loading and unloading bodies on conveyors, loading and unloading presses, conveyors, presses, loading and unloading of hydramatic welders . . .

In an operation dealing with very small quantities of very precise machining and assembly (number of individual piece parts is high) automation will be in repetitive machining, some engineering calculation, some production control . . .

Control and distribution of equipment . . . Track assignment in automatic switching yards . . .

Material handling operations . . . Data processing, production control, all accounting functions . . . Increased application to office and records . . . Assembly operations of subassemblies, lines for parts; not now made in the plant . . .

Components

Servotran . . . Mechanical variable speed drive . . . Infinitely variable forward and reverse . . . Lot control force making it adaptable to automatic marking requirements . . . Drilling and screw setting . . . Telecontrol . . . Manual production control and monitoring equipment . . . Automatic production control . . . Tube bending and forming for upholstery . . . Metal forming, punching, and shearing . . . Mechanical power amplifier . . . Servo actuators . . .

Synchro data converter . . . Vernier controlled speed servo . . . Temperature monitor systems . . . Fully automatic electronic test equipment for in plant quality control checking or complete military weapon testing . . . Automatic testing systems for guided missiles and aircraft . . . Shaping of exotic refractory metals . . . Special impeller machines . . . Test stand equipment automatic check out equipment . . . Systems design for automation . . . Controls for earth moving and refrigerator car equipment . . .

SIC 38—INSTRUMENTS

Equipment

Major improvements can be made in small parts material handling . . . Small operations are being continually semi-automated . . . Air cylinders and their respective valving are coming in strong . . . Repetitive assembly and machining of non-complex items . . . Various phases of photograph film and paper manufacturer such as emulsion marking, coating, speed regulator, drying and determining the dry point, cutting to size and packaging . . .

All lens processing equipment . . . Paper processing, coating and finishing . . . Sun glass assemblies, surface coloring and inlays . . . Some assembly where quantities are sufficient . . . Calibration and test equipment . . . Special laminating . . . Cleaning, processing, polishing, inspection . . . All phases of product assembly and conveyor systems . . . Automatic testing of products . . . Electronic instruments . . .

Testing . . . Computer control of production facilities . . . Sales order analysis and forecasting . . . Order processing, inventory records, cost accounting . . . Material handling . . . Packaging . . . Weighing . . . Plastic molding . . . Finishing . . . More manual operations will be mechanized . . .

Components

Electronic instrument controls . . . Digital storage devices . . . Translating and computing modules . . . Program sequencing modules . . . Printers and numerical indicators . . . Inspection, quality control gaging, mixing . . . Inventory control . . . Recording instruments . . . Automation for controlling oil wells . . . Oil well metering systems . . . Quality control center to compute variances is processing . . .

Container inspection, rejection system . . . Container fill level control system . . . Tank level detector-controller . . . Continuous tank level system . . . Testing equipment requiring automatic control of operating level and program of function versus time . . . Dimensional control systems . . . Inspection systems . . . Positioning devices . . . Programming devices . . . Speed control with feedback . . . Electro-caloric flowettes . . . Pneumatic and electrical flow rate transmitters for control . . .

Computers, analyzers . . . Telemetering . . . Multiplex transmission . . . Pneumatic controls for missiles . . . Electronic cotton classing device . . . Impact tester . . . Drives, cutters, winders, temperature control systems, high temperature calenders, ram type extruders, drive analyzers, fault finders . . .

SIC 39—MISCELLANEOUS MANUFACTURING

Equipment

Brush assembly, roller packaging, stock preparation, chemical additions, production machines, assembly operations . . . Material handling . . . Clay handling, charging molds, batch weighing for cupolas, transfer of materials in process between different operating stations . . . Automation of the finishing coat of lacquer that covers the printed pencil . . .

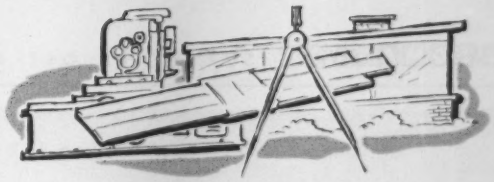
All archery manufacturing facilities . . . Ball point cartridge loading, ball point pen assembly, mechanical pencil assembly . . . Automation of manual varnish making operations . . . Molding operations, compression and injection . . . Mold changing . . . Feeding plastics extruders . . . Counting and packaging plastic containers, shearing plastic paper laminates to length . . Radio communication with field crews . . . Painting of display pictorial . . .

More assembly and processing equipment . . . Machining operations, finishing, inspection, packaging, plating, control . . . Machines to do multiple operations . . . Metal button manufacture . . .

In industries where products are constantly changing difficult to predict . . . If dependent upon the automotive industry, a shift in automotive design would change setup . . .

Components

Modernizing older equipment with special pneumatic devices and latest controls . . . Assembly machinery . . . Plastic molding controls . . .



SIC 8911—ENGINEERING AND ARCHITECTURE

Equipment

Machine tools, machining, welding, feeding . . . Production tooling for winding special springs . . . Painting . . . Power and pumping plants . . . Handling, conveying and transferring . . . Probably x-ray and spectrographic analysis . . . Assembly . . . Test and fault location (electronic organs) . . . Molding equipment, waste paper and other pulp material disposal . . .

More data processing . . . Computers to process records of local business on a daily, weekly, monthly, yearly basis . . . Specification typing and routine engineering . . . Calculations in mechanical and electrical fields . . .

Components

Material handling—Aircraft and airport loading and unloading equipment . . . Mechanical loader and extractor—iron hands with specially cushioned adjustable stroke cylinder . . . Press room unloaders . . . Automatic pan dumping and transfer machine for bakery . . . Low cost overhead conveyor for light load . . .

Electro-matic pallet conveyor for automatic assembly and testing of electric products . . . Press and machine tool transfer units . . . Precision bulk feeders . . . Improved parts feeders . . . Special feeds, reversing and transfer devices . . . Automatic package sorting conveyors . . . Transfer mechanism . . . Automatic machine feeders (high speed) . . .

Vibratory rotary and straightline feeders . . . Automatic overhead trolley conveyors . . . Gripper devices for holding parts during transfer through operation stations . . . Egg handling and processing equipment . . . Pneumatic placing of concrete . . . Special orienting devices for parts that cannot be oriented 100% in conventional parts feeders . . .

Automatic paper stacking and jogging devices for offset printing machine . . . Automatic transfer device for adaptation to standard punch press . . . Tube feeder . . . Universal escapement . . . Special powdered metal pressed parts palletizer . . . Electrical controls of system for scheduling and controlling flow of mail and use of manpower in post offices . . .

Controls for handling and processing shellfish . . . Controls for handling glass blocks, coloring and glazing face of cement blocks . . .

Controls—Automatic boring run-out controller for deep boring . . . Ultraprecision gaging devices . . . Timing devices . . . Remote controls in the motion picture industry . . . Supervision and operational control and instrumentation for water treatment plants, for remote water pumping units, for sewage treatment plants . . . Automatic valve operators . . . Air pressure regulators . . .

Special dimensional control systems . . . Perforating control . . . Counting device . . . Predetermined counts . . . Punch card type control of equipment . . . Newspaper counter counts to 60,000 per hour . . . Exposure control for microfilming equipment . . . Electronic feedback controls . . .

Predetermined counters . . . X-ray inspection . . . Voice control systems . . . Sensing unit to stop machine when probes, drills, or cutting tools fail to feed in or break . . . Conveyor, batch level, and automatic feeding controls, glass level controls, automatic air valve reversal controls . . . Automatic medical indicating equipment . . . Production cycle timers . . .

Packaged units for pump controls, density controls, engineered liquid controls . . . Vibration sensing units . . . B. S. & W. Monitors . . . Cut point indicators . . . Liquid fuel control . . . Telemetering . . . Remote control regulatory systems . . . Numerical controls . . . Process computers . . .

Relays and switches . . . Gum fountain controls . . . Automatic web controls . . . Data processing control panel . . . Computer console . . . Automatic control valves for the food industry . . . Automatic cutoff machines for plastic industry . . . Automatic coffee bean grade separator . . . Automatic control device for plastic extruders . . . Programming systems and equipment . . .

Speed control systems and equipment . . . Chemical and nuclear industry computers, controllers . . . Formation logging instrumentation . . . Electro-air control for precise belt grinding of contour forms . . . Combustion control equip-

ment for coal . . . Utilization of a computer for stock ticker monitoring . . . Data processing system for airline . . .

Equipment—Stamp-coil winding . . . Stamp dispensers (postage and trading) . . . Automatic pin setter . . . Efficient recovery of waste paper and other fibrous materials and the conversion of these materials by automatic equipment into packaging materials, products, and shapes . . . Shell molding equipment . . . Transfer type machine tools . . .

Shearmatic, pressmatic feeders, puller . . . Inspection and packaging machinery . . . Trade register listing for Toronto Stock Exchange . . . High speed coating and roll change equipment . . . Complete intaglio press . . . Special type producing machine . . . Special wood stave boring machine . . . Automatic riderless sawmill carriage and allied equipment . . . Automatic data printer for oil well testing . . .

Water detector for crude oil . . . Telemetering system for remote control of oil wells . . . Processing and testing equipment for dried fruit and nuts . . . Roll form cutoff equipment . . . Wire cloth looms . . . Automatic machine for the forming of metallic tubs . . . Packaging machines . . . Assembly machines . . . Foundry automatic units, hydraulic, pneumatic, and mechanical: Mixing, shaking unit including molding, conveying, assembling, rolling, shell molding . . .

Equipment—Set on units on continuous conveyor . . . Equipment for machining, inspection, casting, and mold making . . . Printed circuit manufacturing equipment . . . Automatic welding machines . . . Automatic shank slotter for screws, hopper feed . . . Automatic slitter and chopper (cutter) for processed photocopy paper, operating on a basis of photo-electric cell engaged by black spot on moving strip of paper . . . Packaging equipment . . . Hi-speed label dispensing equipment . . .

Automatic band knife for cutting paper rolls . . . Dial type assembly machines . . . Package engineered servo systems . . . High speed wrapping machinery . . . Automatic continuous multicomponent weighing and mixing process line, approximately 50/50 on sensing devices and controls as to whether standard or special design . . . Equipment for baking 160,000 hamburgers every two hours . . .

Vibration measuring equipment . . . Surface measuring equipment . . . Automatic addressing equipment . . . Type controlled machine tools of superior quality . . . Cloth slitters . . . Cookie packaging equipment . . . Automatic machinery to clean and repair leaks in sewers, municipal deep well pumping systems through hydropneumatic pressure tanks . . . Sprinkler and flood irrigation systems . . .

Coal cleaning machines hydraulic . . . Coal cleaning machines heavy media . . . Pizza machines . . . Pretzel machines . . .

Miscellaneous—Shock absorbing pads for heavy machines . . . Hydraulic servo systems . . . Simple rugged mechano hydraulic scales 20 tons . . . Position sensing devices for materials . . . Automatic weighing, batching, and processing components and systems for bulk materials . . . Automatic inspection, sorting, and packaging of light bulbs . . .

Electric clocks for advertising displays . . . Variable speed and feed drill head units . . . Pneumatic proximity transducer . . . Electronic gage for holes from .020 to .040 diameter and a cambre gage for the same range of hole sizes . . . Automatic garbage disposal units . . . Automatic labeling, sorting, packing, and bundling unit . . . Automatic burn out detector for nuclear test coops . . . Electronic parts assembly . . . Mechanical parts assembly . . .

Steam lined parts and components . . . Line of high pressure hydraulic cylinders . . . Proportional flow pumps . . . Cosmic ray cameras . . . Other camera and optical equipment for rocket use . . . Ozone test and atmospheric ozone sampling equipment . . . Special equipment for ozone and rocket use . . . Blending of colored granules for the asphalt roofing industry . . .

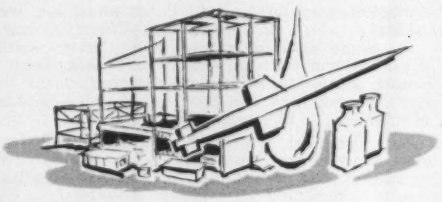
Servo valves . . . Hydraulic and pneumatic actuators and transducers . . . Continuous feeding and winding units . . . Tension devices for paper and steel industry using hydraulic, pneumatic, electrical, and mechanical components . . . Automatic navigational systems . . . Flexible wave guide for radar and production equipment . . . Standard electrical panel . . . High speed switches . . .

Component handling, insertion, and automatic soldering . . . Applications in automatic, mobile, packaged, hydraulically powered, electrically operated, electronically controlled oil well drilling rig . . . Automatic bag packer for supermarkets . . . Automatic pipette puller, medical application . . .

Processes for vacuum packaging using new processes involving patents issued and pending . . .

Automatic processing for electrical meter manufacture with new devices for color selection or rejection, electronic and mechanical or electronic gaging . . . Automatic stock houses and blast furnace charging systems . . . A synchronous pulse generator for timing signals . . . Magnetic memory equipment . . . Stepping or sequencing switch for direct operation of solenoid valves . . .

Automatic release agent and lubrication applicators for die-casting dies . . . Automatic devices for use in district insurance offices . . . Automatic devices for residential uses . . . Grinding wheel forming and finishing . . . Automatic display type caster for printing industry . . . Waste control and disposal systems . . .



OTHER SIC's

Equipment

Coal hoisting, coal conveying, coal processing, coal mining, coal loading . . . Dumping and preparing coal . . . To the greatest possible extent in the iron ore beneficiation plant . . . Mining and transportation equipment . . . All ore handling and processing equipment that is feasible . . . Hydrotator for barley size coal . . . Hydrotator for rice size coal . . . 1000 hp, 6000 GPM—deepwell centrifugal pumps 500 ft TDH . . . Underground belt haulage system . . . Quality control dense media washer . . . Computers for payroll, invoicing, statistics, engineering problems . . . Instruments and remote controls . . .

Automatic custody transfer of crude oil . . . Loading racks . . . Water pumping system . . . Feeding of materials . . . Conveying . . . Temperature control . . . Boiler and kettle fire control . . . Heavy machinery and controls for cement plants, aluminum plants . . . General machining operations, assembly operations, processing, machine tools, batching (explosives) . . . Processing equipment pertaining to the manufacture of ammunition components . . . Record keeping, inventory control, production control . . . Material handling . . . Power house refrigeration system . . . Office systems and warehouse operations . . . Warehousing . . . Ordering on vendors . . . Bottling, casing, cleaning . . .

Complete automation of data processing through IBM 705 system . . Further data processing and perhaps some laboratory facilities . . . Analysis data reduction of many aspects of water resource investigation . . . Analysis of geophysical and geochemical data . . . Many aspects of topographic map making . . . Almost all administrative type work such as accounting and personnel . . . Deposit accounting, stock transfer, payroll and employee benefits, mortgages, installment loans . . . Clerical sections . . . Production machines . . . Receipt, distribution and dispatch operations including machines for reading typed addresses . . .

Components

Automatic gaging in plywood plants . . . Special tooling on furniture . . . Case selling equipment, sheet jogging, die cutting of sheet stock after processing in converted paper products industries . . . Pumps, conveyors, and cleaning equipment in the coal industry . . . Increase in instrumentation by oil producing companies in the field of automatic custody transfer of crude oil . . .

Use of air controls in paving mixtures and blocks . . . Automatic dumping equipment for canned fruits and vegetables . . . Automatic fastening devices: Studs, rivets, screws . . . Automatic positioning devices such as dials, transfers in automotive industry wholesalers . . . Industrial wholesalers of machinery and equipment are developing line index slide assemblies . . .

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AUTOMATION
A PENTON PUBLICATION . . . CLEVELAND 13, OHIO

He's been working on the railroad . . .

the TRS rivet man found a $7000 saving in A. C. Gilbert's train transformers

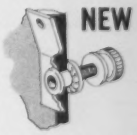
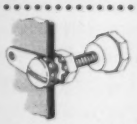
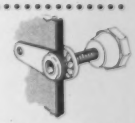
You needn't be rich to give your boy a fine American Flyer train because Gilbert never misses a possibility for reducing costs.

For example, they challenged a TRS sales engineer to find ways to save on transformer assemblies. He uncovered *two* . . . worth $7000 on a year's production.

Invite the TRS man to check over your assemblies. You'll find that he is more than a salesman . . . that he has the viewpoint of a manufacturing engineer. Chances are he can contribute practical ideas for making your assemblies simpler, faster, better.

Of course he sells rivets. And he can give you sensible reasons why TRS Tubular Rivets are more reliable in essential qualities and uniformity. Ask to see the TRS Quality Control Album . . . one significant result of a five-year modernization of this pioneer company. Modernization of people, policies, production and service facilities. *You'll like to do business with the new TRS . . . we'll make sure of it.*

SEE WHAT THE TRS MAN FOUND

OLD	NEW
	
Found: Contact fastener and binding post. Expensive brass stud machined from hex stock, 8/32 thread, and brass nut. Hex must be recessed in plastic to stop rotation.	**Suggested:** Low-cost 10/32 threaded collar rivet and nut of steel. Automatically clinched to hold firm without hex or recess. Underwriters' ok'd change to steel if 10/32 thread.
	
Found: Five-piece lug fastener and binding post . . . expensive 8/32 brass screw and hex lock nut, 2 lock washers, brass terminal nut.	**Suggested:** Low-cost threaded steel collar rivet and steel nut, 10/32 thread.

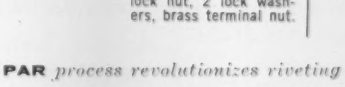
Don't Buy Riveting Machines until you learn how the TRS **PAR** *process revolutionizes riveting*

TRS®

TUBULAR RIVET & STUD COMPANY

QUINCY 70, MASSACHUSETTS • Midwest Office & Warehouse in Chicago. Branches: Atlanta, Buffalo, Charlotte, Cleveland, Dallas, Detroit, Hartford, Indianapolis, Los Angeles, New York City, Philadelphia, Seattle, Springfield, St. Louis. See "Yellow Pages" for phone numbers.

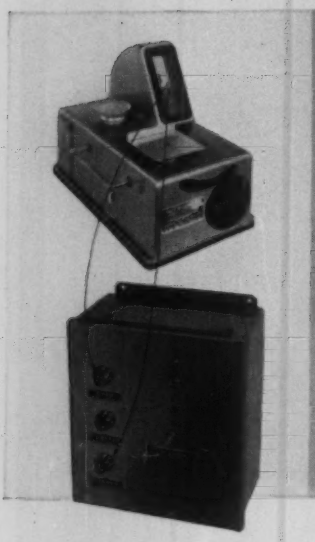
If it's a Tubular Rivet TRS makes it . . . and Better



Circle 663 on Page 129

BASIC WEIGHT CLASSIFIER

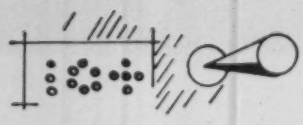
...new aid for controlling your quality and costs



CHECKWEIGHS
products
packages and
assemblies

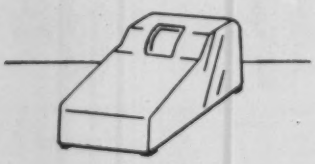
CLASSIFIES
by weight

. . . and through electronic controls, performs these and many other remote functions!

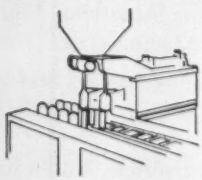


OPERATES SIGNALS

ACTUATES MECHANISMS



RECORDS DATA



CONTROLS PROCESSING

Now you can checkweigh or classify items by weight and utilize the data wherever you need it — and in the form that best fits your needs. The Basic Weight Classifier, employing Shadograph Scale with photocell controls, provides electronic signals which indicate correct weight, or over or under within pre-set limits. Any number of classifications from 2 to 128 may be used. Units are available to handle items in any shape in a capacity range from 2,000 milligrams to 100 lbs. Write for Bulletins 3333 and 3347.

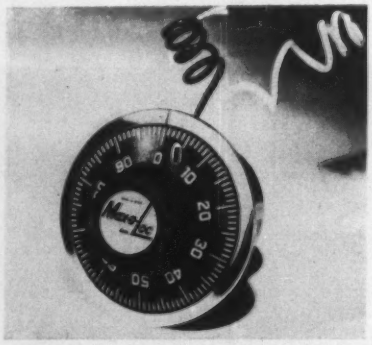
Exact Weight SCALES

THE EXACT WEIGHT SCALE CO.
907 W. FIFTH AVE., COLUMBUS 8, OHIO
In Canada: 5 Six Points Road, Toronto 18, Ont.

Sales and Service Coast to Coast

Find us in your local 'Yellow Pages'

BETTER QUALITY CONTROL . . . BETTER COST CONTROL



ELECTRICAL combination lock developed by Max-A-Loc Inc. has no tumblers and is pick-proof and burglar-proof. Only by rotating the dial knob in a proper sequence of numbers can anyone gain access to a building, turn off a burglar alarm, or use equipment or machinery. Lock has passed salt spray, humidity, sand, dust, vibration, and temperature tests required for military specifications.

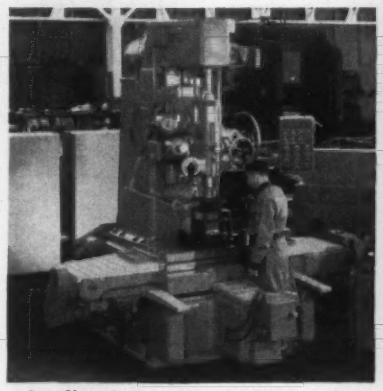
SCIENTIFIC apparatus maker has developed an automatic gear inspection device, used in a General Motors Corp. plant, which tests 14,000 gears every work shift. The system matches gears to each other, and automatically discards defective gears.

SPOTLIGHTING PEOPLE

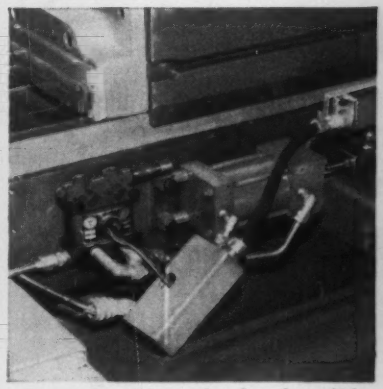
Joseph Hussey appointed manager of engineering for Berkley Div., Beckman Instruments Inc. . . . **E. L. Decker** named assistant chief engineer of Fuller Co. . . . **Harry B. Randall Jr.** appointed New York district manager of Pratt & Whitney Co. Inc. . . . **Frederick S. Mitchell** named chief engineer-industrial products, **William J. Stolze** appointed manager of technical staff, and **Leslie D. Catlin** named manager of engineering services for the Electronics Div., Stromberg-Carlson . . . **Adam J. Alt** appointed general superintendent at Wilbur B. Driver Co. . . . **Roland Lehr** elected president and **Fred F. Miller** appointed vice president in charge of engineering at Gear Grinding Machine Co. . . . **Roy C. Norton Jr.** named chief engineer of the recently formed Automotive Div., Saco-Lowell Shops . . . **Frank C. Mullaney** elected vice president of Control Data Corp. . . . **Richard C. Wynne** appointed vice president in charge of marketing for Non-Linear Systems Inc. . . . **Edward Bachor** appointed assistant

Circle 664 on Page 129

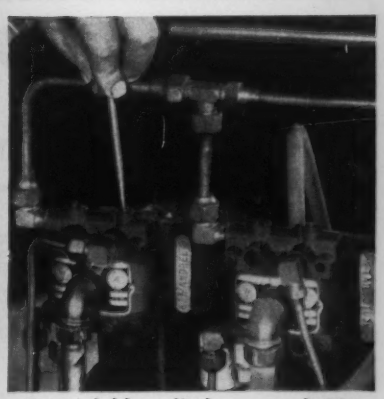
Why Skinner 4-way solenoid valves are used so widely for cylinder control



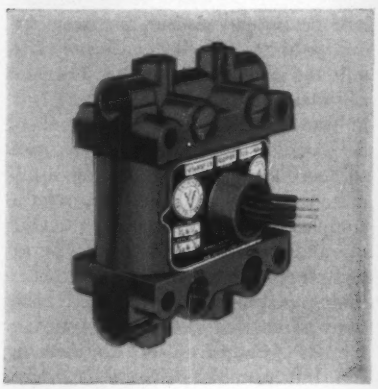
Application: A longitudinal and a transverse slide in this Pratt and Whitney Electrolimit Jig Borer is positioned automatically from numerical data on punched tape or manually by decade dials. When each slide has been correctly positioned it is held firmly by air-actuated, non-influencing clamps. Each clamp is controlled by a cylinder and a Skinner four-way V9 valve.



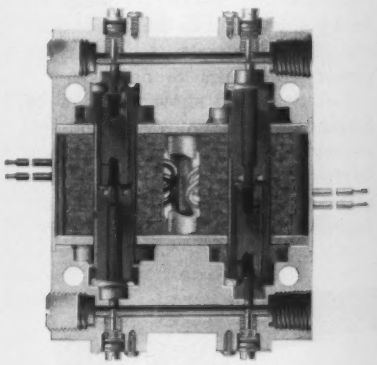
Features of standard valve did job. No special engineering of the four-way V9 valve was required to meet Pratt and Whitney's need. Molded oil-proof coils are used to guard against burnout from cutting solutions. The Skinner valve makes an ideal cross connection between electrical sensing and the muscular air required to provide the clamping action.



Dependable cylinder control. The four-way V9 valve is available with adjustable flow features in the main stream and in the exhaust passage for exceptionally accurate cylinder control. Position of inlet and exhaust connections can be changed easily in the field by simply reversing plugs.



Skinner V9 four-way valves, actually two 3-way valves in one housing are offered normally closed-normally closed, normally open-normally open, and normally closed and normally open. Media: air, inert gases, hydraulic fluids and vacuum; orifices: 3/64" to 1/8"; NPT ports: 1/4"; pressure ratings: to 250 psi. Over 350 basic variations.



Quality workmanship throughout. Internal parts are stainless steel and highly corrosion-resistant. Durable, compressible inserts of soft, synthetic materials insure bubbletight operation. Orifice seats have radius with well-rounded contact area and high finish for long insert life. Valve can be mounted in any position.

Exceptional life expectancy. Skinner valves, engineered to the highest UL standards, are life-cycled in the lab at speeds as high as 600 cycles per minute. In these tests, the V9 valves regularly get over 20-million cycles without leakage. And these results are constantly proving out in service.

Skinner solenoid valves are distributed nationally.

For complete information, contact a Skinner Representative listed in the Yellow Pages or write us at Dept. 321.

SKINNER ELECTRIC VALVES

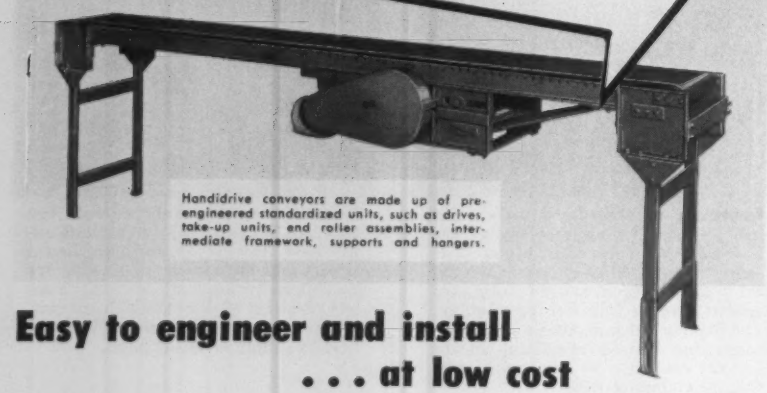
THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION
NEW BRITAIN CONNECTICUT
105 EDGEWOOD AVENUE

Circle 665 on Page 129

NOW..."custom plan" your conveyor system with Standard HANDIDRIVE

and Standard units for complete belt, "live" roller and gravity roller set-ups



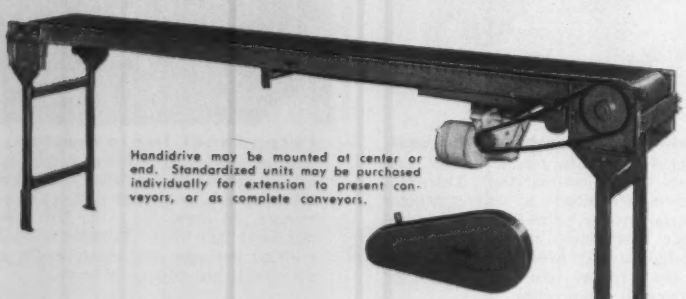
Handidrive conveyors are made up of pre-engineered standardized units, such as drives, take-up units, end roller assemblies, intermediate framework, supports and hangers.

Easy to engineer and install . . . at low cost

You can assemble and build a system "custom-planned" to suit your individual needs with Handidrives and other Standard units available out of stock. This service enables you to adapt and change the system from time to time to meet varying requirements as they arise, at exceptionally low cost.

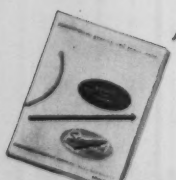
Handidrive conveyors may be individually leveled or inclined. Independent units may be purchased separately to construct power conveyors as desired.

Let Standard show *you* how to build or convert your own conveyor systems with Handidrives. Write: STANDARD CONVEYOR COMPANY. General Offices: North St. Paul 9, Minn.



Handidrive may be mounted at center or end. Standardized units may be purchased individually for extension to present conveyors, or as complete conveyors.

Ask Standard how to cut costs with conveyors



Send for Handidrive Bulletin No. 64. Write Dept. EE-1.

Standard

GRAVITY & POWER CONVEYORS

Sales and Service in Principal Cities

OVER 50 years of conveyor experience

chief engineer of Electronics Div., Curtiss-Wright Corp. . . . **Warren W. Lee** appointed eastern region sales supervisor for systems engineering of Brown Instrument Div., Minneapolis-Honeywell Regulator Co. . . . **Frank E. Tidball** joined General Kinetics Inc. as staff electrical engineer . . . **Roy E. Anderson** appointed director of quality control for Phillips Control Corp. . . . **Vincent C. Blecker** appointed sales manager of Industrial Div., Eagle Signal Corp. . . . **O. L. Wigton** named to newly created post of vice president-marketing for Hancock Industries . . . **John G. Brooks**, president of the Siegler Corp., named to the board of directors of the Electronic Industries Association . . . **Nathan Cohn** appointed vice president-technical affairs and **John F. Quereau** named vice president-manufacturing for Leeds & Northrup Co.

SPOTLIGHTING PLANTS

American Brake Shoe Co. has started construction of a new research center in Columbus, Ohio. The 30,000 square foot building will be known as the Denison Hydrodynamics Research Center and will be operated by the Denison Engineering Div. . . . **Snyder Corp.** is the new name of Snyder Tool & Engineering Co., manufacturers of special machine tools and automated machinery. The name of the company was changed to avoid misconceptions about the type of equipment manufactured since many people associated the company with the tool and die industry. . . . **Eclipse Fuel Engineering Co.** has purchased Norwalk Valve Co., manufacturers of valves, regulators, governors, filters, and gages for use in industrial process control and gas distribution service. . . . **Consolidated Electrodynamics Corp.** has changed the name of its Central Mfg. Div. to the Electro Mechanical Instrument Div. Major products of the division include dynamic-recording instruments and data processing instruments. . . . **G-V Controls Inc.**, manufacturers of time delay relays, electrical thermostats, and other components for the electronic and aircraft industries, has moved into a new plant in Livingston, N. J. . . . **Warner & Swasey Co.** has become full

Circle 666 on Page 129

owner of Warner & Swasey Research Corp. and has changed its name to Control Instrument Div. Recent products of the new division include the Probograph, an instrument for accurately measuring curved surfaces, and the Probomat, a numerical tape control for machine tools.

MEETINGS AND EVENTS

Jan. 12—

Midwestern Simulation Council. Conference will discuss the application of analog computers in control systems and will be held at Allis-Chalmers Mfg. Co., Milwaukee, Wis. Additional information is available from P. J. Hermann, Avionics and Electronics Plant C, Goodyear Aircraft Corp., Akron 15, Ohio.

Jan.12-14—

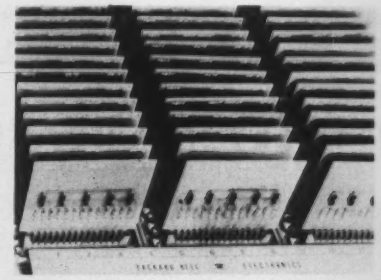
Fifth National Symposium on Reliability and Quality Control. Jointly sponsored by the American Society For Quality Control, Institute of Radio Engineers, American Institute of Electrical Engineers, and the Electronics Industries Association, symposium will be held at the Bellevue-Stratford Hotel, Philadelphia. Further information may be obtained from William H. Rombach, Philco Corp., 4700 Wissahickon Ave., Philadelphia 44, Pa.

Jan. 26-29—

Tenth Plant Maintenance & Engineering Show. Exhibition and maintenance conference to be held at Public Auditorium, Cleveland. Further information may be obtained from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

Jan. 28-29—

Fifth Annual Midwest Welding Conference. Sponsored by the Armour Research Foundation of Illinois Institute of Technology and the Chicago section of the American Welding Society, conference will be held in the Chemistry Bldg., Illinois Institute of Technology, Chicago. Additional information is available from Harry Schwartzbart, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.



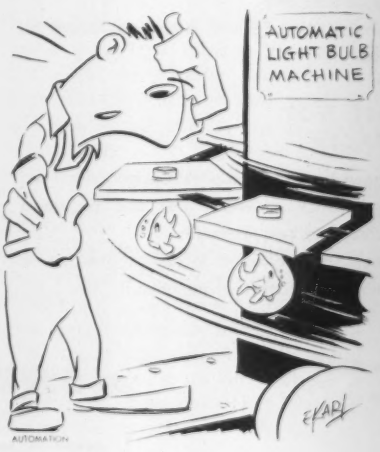
SOLID STATE digital logical packages produced by Packard-Bell Computer Corp. can be combined to build registers, counters, and other data handling equipment. The packages include flip-flops, inverters, gates, drivers, clock generators, etc. Low cost, plug-in modules are easily replaceable and can be built into systems of any size. High reliability is achieved through the elimination of both eyelets and printed circuit connectors. Illustration shows use of modules in an input buffering system.

Feb. 12-13—

Computer and Data Processing in Industry. Conference sponsored by the Dept. of Industrial Engineering, Purdue University and will be held on the university campus, Lafayette, Ind. Additional information is available from Prof. James H. Greene, Dept. of Industrial Engineering, Purdue University, Lafayette, Ind.

March 23-25—

Third Conference on Manufacturing Automation. Co-sponsored by Purdue University and AUTOMATION magazine, conference will be held at Purdue University, West Lafayette, Ind. For information contact the Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio.

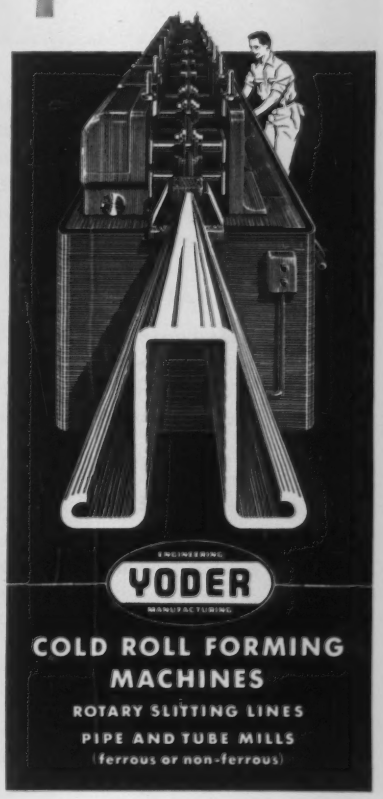


YODER

Roll Forming Equipment—Product dependability—integrity of manufacture—engineering for specific production needs have all contributed to establish Yoder equipment as the industry standard of excellence. Since 1909 Yoder-built machinery, including Pipe and Tube Mills, Roll Forming Equipment and Rotary Slitters, have earned world-wide customer satisfaction and recognition.

Profit from Yoder's years of engineering and service experience. Send today for the illustrated Yoder Roll Forming Equipment Book.

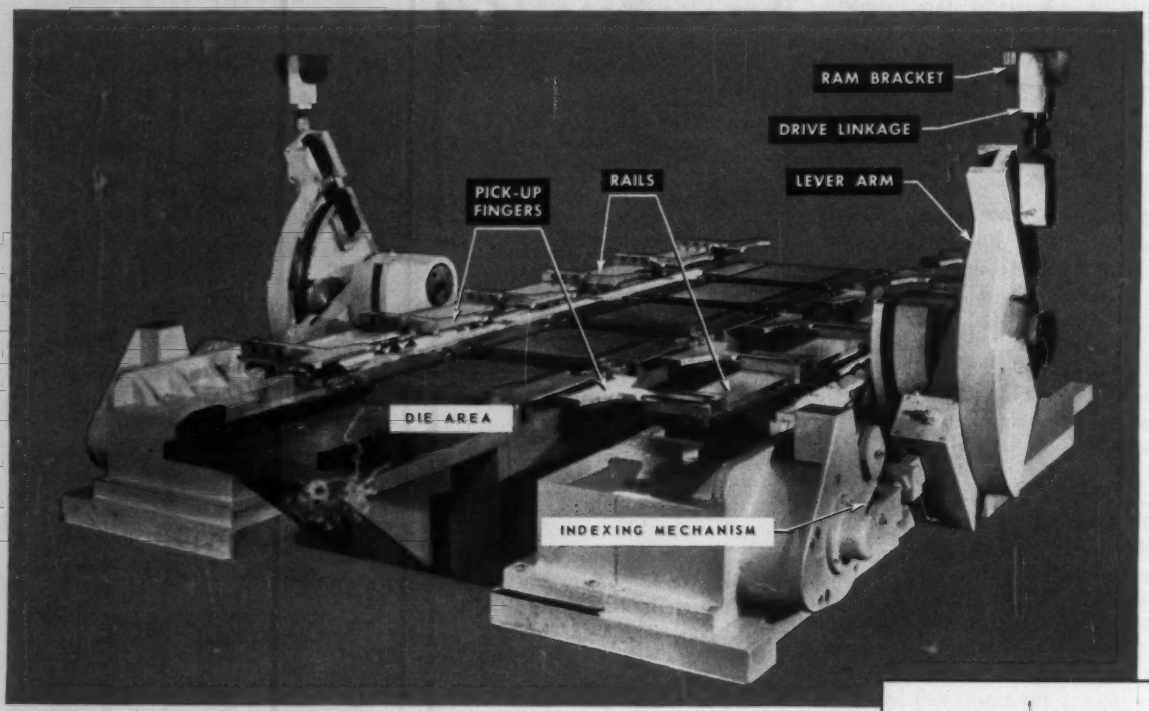
THE YODER COMPANY
5526 Walworth Ave., Cleveland 2, Ohio



Circle 667 on Page 129

SHEFFIELD ~~PRESS PACERS~~

SUBSTANTIALLY INCREASE PRESS OUTPUT



The Sheffield Press-Pacers are all readily demountable transfer mechanisms used to automate one or a line of straight-side presses.

Any number of transfer operations within press capacity may be included. Thus, one press can be made to do the work of several.

Coil stock, blanks or pre-drawn work parts may be handled with equal facility.

OPERATION

The Press-Pacer receives the work and advances it from die to die and from press to press—all automatically.

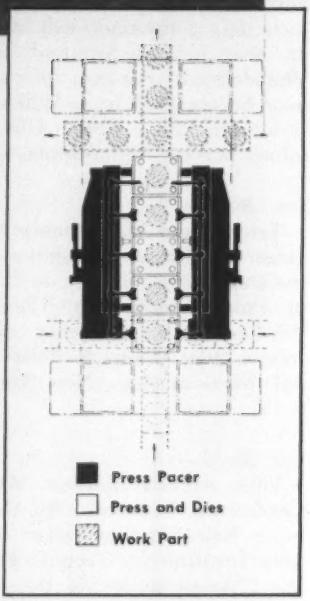
Work parts may be traversed in any desired direction—front to back, right to left or the reverse.

PRODUCT CHANGE DOES NOT OBSOLETE THE PRESS-PACER

Feed fingers are interchangeable and easily replaced when the product is changed. Traverse distance between dies and between presses is fully adjustable to changed requirements.

Installation of the Press-Pacer can be done in just a few hours. It may be removed from a press in a matter of minutes.

8005

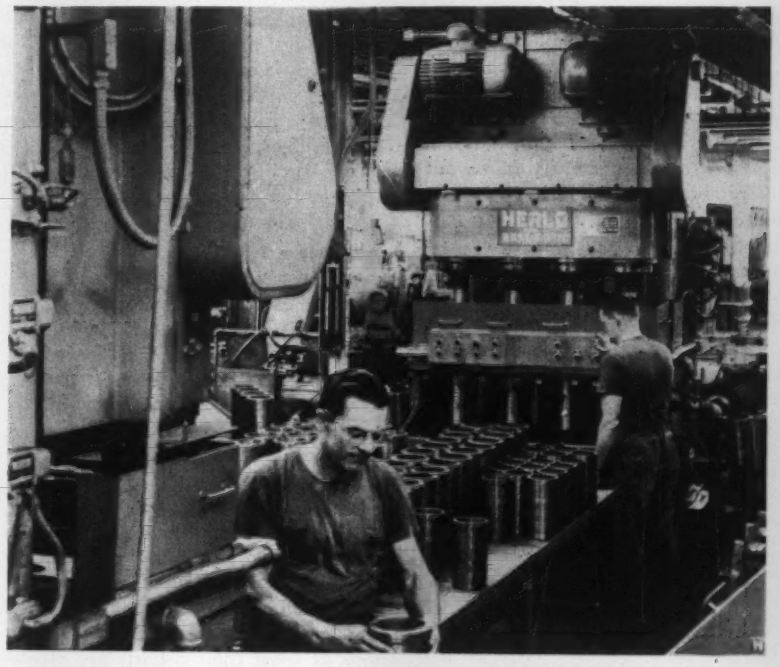


Write for Catalog No. PP3M-57 to the Sheffield Corporation, Dayton 1, Ohio, U.S.A., Dept. 3.

the SHEFFIELD corporation
of Bendix Aviation
manufacture and measurement for mankind

Circle 668 on Page 129

By JAMES C. KEEBLER Managing Editor



Largest single unit machine tools built to date by Heald Machine Co. are used to machine diesel cylinder liners at Cummins Engine Co. One vertical-slide machine roughs the bores, another finishes them. With four parts loaded and hydraulically clamped, the slide moves down in rapid traverse, slows to bore, and reverses to loading position where work is unclamped.

Enthusiastic Optimism

TRADITIONALLY this columnist kicks off the new year with the words "I am at heart an optimist." There is no reason to break with precedent now. It is only fair to acknowledge that the idea came from some of the writings of Will Rogers, and it seems to stand the test of time.

If you discuss this matter with anyone who is old enough to know, you'll probably learn that this guy Rogers got famous by claiming that all he knew was what he read in the newspapers. The newspapers in turn made him famous.

You Too Can . . .

There's a saying used by some enthusiastic staffers here: "Just tell 'em you read about it in AUTOMATION." And some of the enthusiastic comments that come in from manufacturing engineers would lead you to believe they tell people that all they know about automation is what they read in the magazine of the same name. Such praise of publishing effort is well received in the editorial offices; however, no commitment to bring fame to the sendee can be given.

Be the Life of . . .

Despite the fact that the editors spend considerable time in the field talking to countless automaters, they find it necessary upon occasion to formally ask the readers what they're conniving to do. There is a feeling in these halls that it would be more enjoyable to do this by making a personal call on each name on the circulation list (and taking them all to lunch in their turn). But there are too many thousands of you to make this practical, so the result was to use a printed (Keeps the press load above the breakeven point) questionnaire form to survey the populace.

. . . the Party

Because 2693 plants were able to send back an intelligible response, the electronic tabulators were able to show some statistics that make interesting reading. Because the EDITOR is an honest man, he is fulfilling his promise to reveal the results to the respondents, by publishing a report on pages 17 through 32 of this issue. Here, for all the world to see, is the reason for the January 1959 optimism.

It adds up to the fact that the 5 billion dollar cause for celebration is that automation, the technology, has become basic to American industrial operation. (And probably foreign too, but this survey was not exported.) When it becomes so apparent that people in so many different industries are spending such a pile of dough on more automatic operations, it is also apparent that the keen students who are in this business for the joys of being educated are going to learn a lot by following these developments. (Likewise the shrewd vendors who are in it for the money are quite likely to make a lot in the process.) The automakers are certain to become better off too.

Big Picture—with Details

This report is done up in the best presentation you are likely to see for some time to come. (In this age of evolution, revolutionary ideas are scarce.) For the high-level thinkers who want the big picture the data have been summarized into tables, charts and graphs that portray the conglomerate situation of the status quo and the plans to make the status less quo. Survey data is not only printed as such, but is supplemented with some editorial

forecasting that will help interpret the figures for those doers that are anxious to get things done. For the meticulous minds that want specifics of what is being planned the report also includes seven pages of answers to that question. If your imagination hasn't been challenged by what has been published in this journal previously you are sure to join the ranks of the enthusiastic by reading this Survey Report and Forecast.

Land, Air, and Water

By turning to page 30 (Tear this page out so you won't have to find your place again) you will see the breakdown for SIC 37. Don't lose your optimism by assuming that SIC 37 means that the transportation equipment industry is going to be *Sick* for 37 years. SIC means Standard Industry Classification and is a system of classifying establishments by type of activity in which engaged, so that statistical data collected by various agencies of the U. S. Government can be presented with a degree of uniformity and comparability that would not otherwise be possible. The scope of the system is so broad as to cover every field where there's a buck to be swapped. (Industrial publishers wisely tie-in with this system because it enables them to phase-in with the biggest fact finding operation in the world—the U. S. Givvermint.)

For those automakers who are already teed off because the cartoon shows more than autos (any similarity between the auto shown and any model currently in or out of production is purely co-incidental) it must be made clear that the SIC Manual published by the Bureau of the Budget defines transportation equipment as including all devices for moving passengers and cargo on land, air, and water. You rubber-tired engineers must be made aware of the fact that the man-on-the-seat may also be in a boat, bicycle, or horse-drawn vehicle. (Cheer up. The SAE also includes land, air, and water and the *Detroit Dateline* column in AUTOMATION often covers auto activities a fur piece from Detroit—nothing in 1959 is categorically simple.)

U. S. Government figures show that the auto industry buys 10 per cent of the nation's new machinery.

Automakers also buy considerable parts and materials from the other SIC groups, so that the chain reaction of increased auto business is felt in the general economy in more ways than one. Many of the manufacturing improvements contemplated by automaters in other industries will directly affect the auto industry through the products it buys. These techniques, applicable to the products it makes, will also represent ideas that can be put to useful advantage.

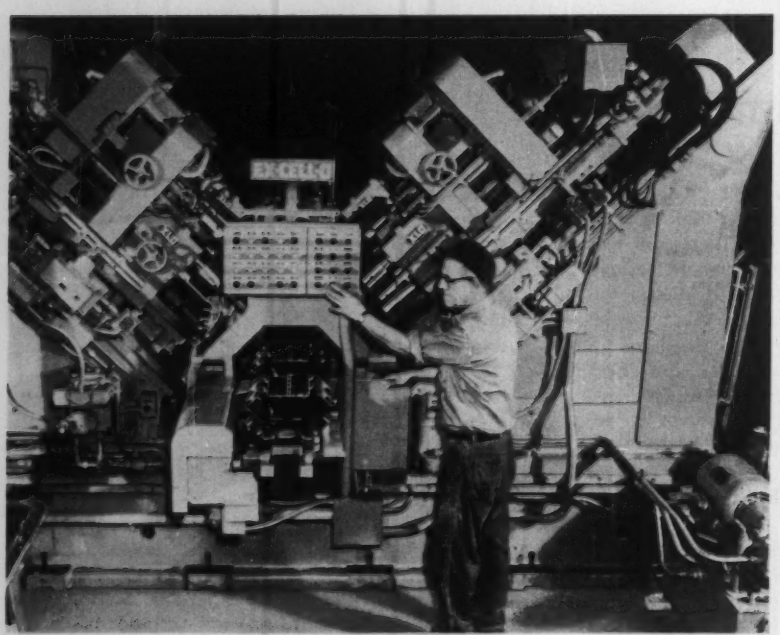
Some writers have said the industry is sick, the customers are sick, the cars are sick, the tool shops of Detroit are sick, and the future looks sick. Some see the '58 recession as only a sniffle. AUTOMATION's survey was answered by a lot of people with healthy plans.

Plan Ahead

It is suggested that while the stylists are busily having the nation psychoanalyzed by motivation researchers to put the hoopla back in the sales curves, the manufacturing engineers are taking a good look at what their cohorts are planning (don't stick to SIC-37—those other SICs have good ideas too) and are planning to meet the demands of an expanding market with more automatic operations.

Engineering colleges are putting the emphasis on engineering sciences rather than the practical problems of production. The auto industry is moving across the nation with manufacturing facilities, rather than hide out in Detroit. The sales curves are on the up-turn. The headlines are optimistic. The challenges are big. The year could be a real boomer. Tabulate my vote next to Will's. I am at heart an optimist. Score this bird as saying it will be.

You don't have to wait for the next AUTOMATION survey to tell the EDITOR what you're doing. He'll gladly read your mail anytime. You too can join the ranks of those enthusiastic inquirers who write in to find out who is doing what, or who can help out with a problem. The spontaneity of readers' participation in affairs editorial enables a journal such as this to make a larger contribution to the progress achieved by the readers who spend the 5 billion bucks.



Pallet-type transfer machine is built by Ex-Cell-O Corp. for rough and finish boring aluminum V-4 engine blocks for outboard marine motors. Due to close center distances two engine blocks are partially machined at each cycle.

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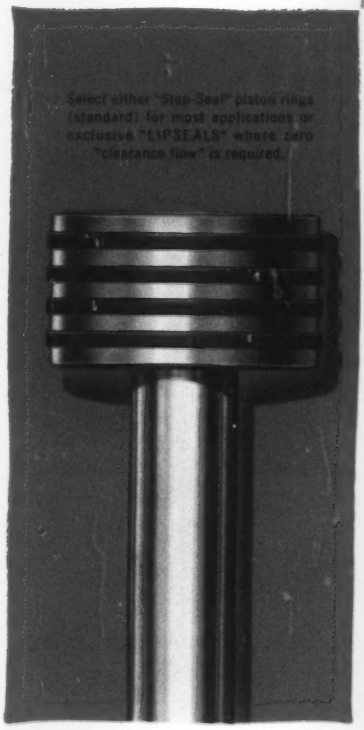

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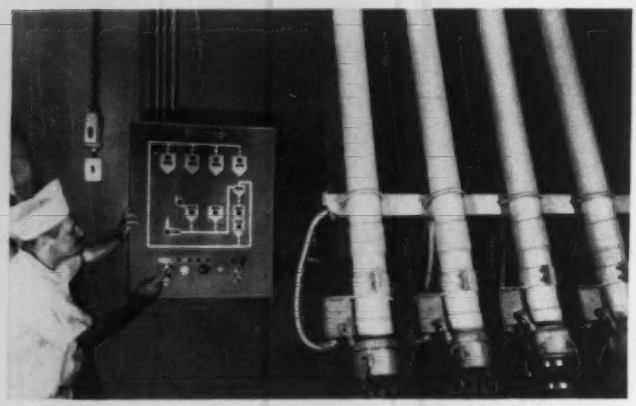
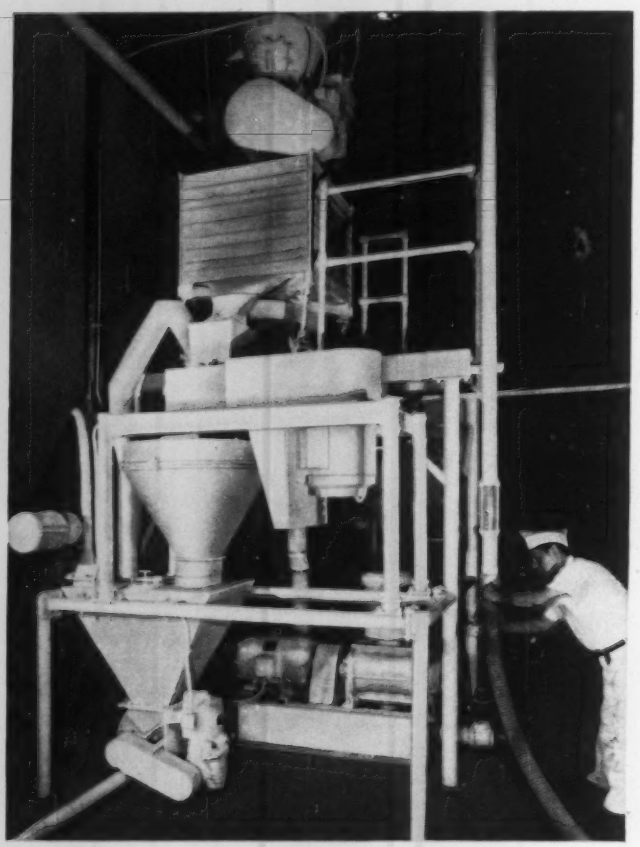
The Arithmetic of Materials Handling



Central Control Panel of Jewel Tea's flour-handling system. At right are main conveying lines—each to a separate bin.



FULLER

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Automation . . . at the new Jewel Tea Company bakery in Melrose Park, Ill., . . . means baking more than four tons of bread an hour under the highest standards of sanitation, at the lowest possible production cost. A Fuller-engineered *pneumatic* flour-conveying system helps make this record performance possible.

This automatic, smooth running pneumatic conveying system is controlled by one man and a centrally located push-button control panel. By making a simple connection, turning a switch and pressing a button, the operator empties 100,000 lb. GACX Airslide carloads, of bulk flour, into storage bins. Other buttons send the flour through predetermined cycles of sifting, weighing, mixing — in dust-tight, self-cleaning pneumatic lines.

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←Previous Page Circle 669

Circle 670 on Page 129

No Less

From the standpoint of the practical reality of automation, what was once only a gleam in an engineer's eye has now assumed the proportions of a maturing technology. From the broad picture of present activities revealed by the Survey Report and Automation Forecast featured in this issue, the impression gained is one of growing activity and accomplishment, of economic drive, and plain necessity.

Highlighting this trend in all industry are some highly significant comments by Clarence H. Thayer, vice president in charge of manufacturing, Sun Oil Co., in the article beginning overpage:

". . . there are many factors which make automation at an increasing rate inevitable. . . . some companies will forge ahead as a result of automation. Others, not realizing its potentiality and inevitability, will fall by the wayside.

"Designing and creating an organization compatible with an automation system can be accomplished most easily when the organization and the system are combined in a brand new plant . . . the much more difficult jobs of designing systems and organizations and fitting them into existing plants will be forced upon us increasingly. . .

"Our primary objective is to bring our older plants up to a point of efficiency, through automation and reorganization, that will enable them to compete effectively with the new ones. To that end we have recently established within the Manufacturing Department an entirely new organization known as the Advanced Management and Methods Division. It is charged with responsibility for studying refinery operations, designing automation systems and the organization required to operate them, assisting in their installation, and, finally, conducting necessary evaluations of the results. The division consists of two sections, one dealing with the development and design of automation equipment and instrument engineering and installation, and the other with the application of the automation equipment and the required reorganization of supervision and personnel. . ."

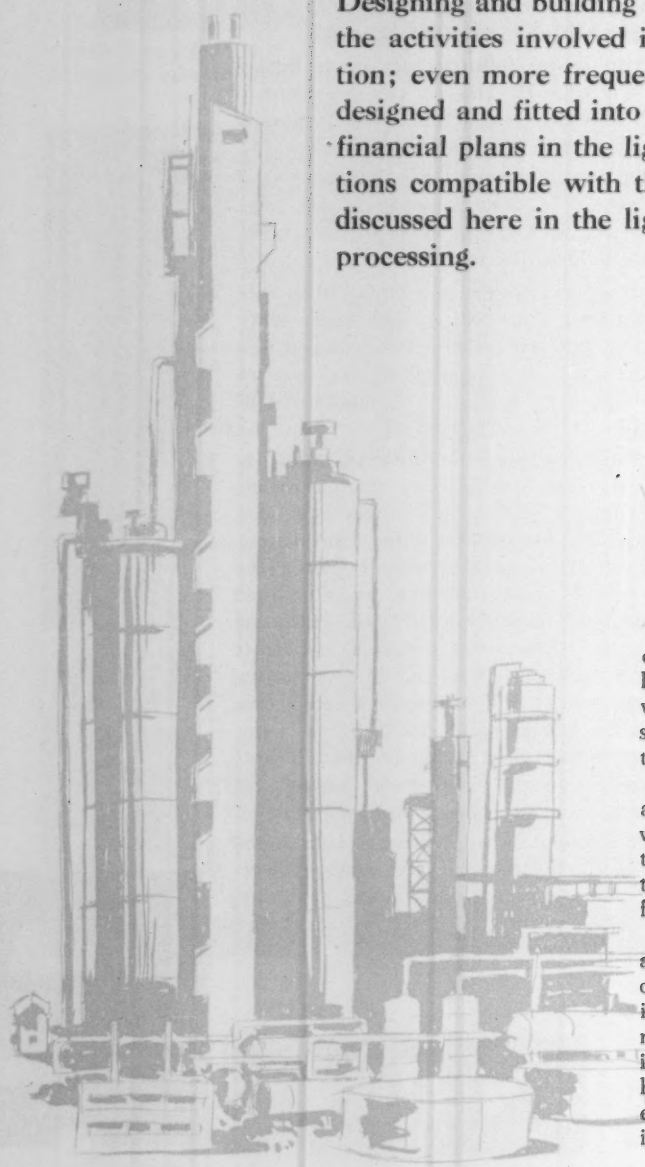
Success in the age of automation, so strikingly silhouetted in the survey, demands broad talents and a fresh new engineering approach. No less a management program than that outlined by Mr. Thayer can be expected to meet the challenge.

EDITOR

MANAGEMENT CONSIDERATIONS IN

APPLYING AN AUTOMATION PHILOSOPHY

Designing and building of new automated plants are only two of the activities involved in capitalizing on techniques of automation; even more frequent are the cases where systems must be designed and fitted into existing plants. Management must make financial plans in the light of these needs and develop organizations compatible with the automated systems. These points are discussed here in the light of practical experience in petroleum processing.



By CLARENCE H. THAYER
Vice President in Charge of Manufacturing
Sun Oil Co.
Philadelphia, Pa.

ASSUMING our free competitive system remains with us, there are many factors which make automation at an increasing rate inevitable. The consumers, the workers, and their families will profit from automation in a tremendous way, and some companies will forge ahead as a result of automation. Others, not realizing its potentiality and inevitability, will fall by the wayside.

What are management's problems in relation to automation? Probably a million words could be written on this subject, but I plan to outline only the approach we are taking to those problems in the hope that so doing might lay the groundwork for developments by others.

The significant problems begin in connection with application of a system in a manner such that the competitive and economic objective of its installation is realized. For example, I believe it is a simple matter to be convinced that an electronic computer is needed in a business, but I'm sure many who have bought or rented them have found it is not easy to put them to work efficiently and profitably in an existing organization. Sometimes it is possible

to apply equipment in areas other than those intended, and thereby salvage part of an unsatisfactory investment. However, a handy alternative may not be always available to some of us who introduce automation into a particular situation only to discover that we haven't been careful enough with our arithmetic.

Successful Automation Requirements

Obviously, the first requirement for the successful application of automation is a potential economic gain exceeding the cost, or perhaps the disruption, generated by its introduction. Reason tells us that we wouldn't put a $50,000 computer to work regulating a single liquid level, unless of course it was very critical, but reason is not always as insistently clear in some of the operations that tempt the mechanical genius of the engineer. Rube Goldberg had a great talent for inventing marvelously automated machines, but so far as I know his machines contributed nothing to production whatever.

The second requirement is that the economic gain from automation must not exist only in theory, but must be capable of attainment in fact. Here we encounter the truly difficult management problems. The plain fact is that automation cannot ordinarily be simply superimposed upon an existing organization. Or perhaps I should say it can be, but the result would most often consist only of higher costs with no offsetting advantages.

Designing and creating an organization compatible with an automation system can be accomplished most easily when the organization and the system are combined in a brand new plant. I will brush aside as relatively easy the problem of designing an automation system, or even of designing and building an automated plant, *new* from the ground up. If management's problems in relation to automation only concerned the designing of a new system or the building of a new plant, we would have fewer discussions on the subject of automation, and management problems would be comparatively simple. But for reasons which I shall discuss, the easy jobs will be coming along less frequently, and the much more difficult jobs of designing systems and organizations and fitting them into existing plants will be forced upon us increasingly.

In either instance, management is confronted with human nature and its resistance to change, with rigidities encouraged by labor unions, and with an appalling lack of understanding of the great contribution to better living for all of us which automation is capable of providing.

Man is a complex being. He has a soul, which makes him equal in the eyes of his Creator with every other man and entitles him to consideration by all men as a free individual. His brains—which he is capable of exercising to a greater degree than he is often challenged to do in industry today—and his individuality must be considered by management, in organization and job assignment, to create conditions that improve his productivity and his opportunity.

THE AUTHOR

CLARENCE H. THAYER, vice president in charge of manufacturing, Sun Oil Co., has spent nearly all his business life in the petroleum industry. In 1914 he entered the employ of the Standard Oil Co. of California, working successively as office boy, shipping clerk, blueprint boy, draftsman, chief draftsman, project engineer, and assistant superintendent of maintenance. In 1926 he joined Sun Oil Co. as an engineer, then served as assistant superintendent and superintendent of pressure stills at Sun's Marcus Hook refinery, assistant to vice president in charge of manufacturing, and chief engineer of the manufacturing department. In 1941 he was elected to the board of directors of Sun Oil Co., and in 1947 was elected vice president in charge of manufacturing.

Mr. Thayer was honored as a Modern Pioneer of American Industry in 1940 for his work in the commercial development of the Houdry catalytic cracking process. He is the holder of several oil process and equipment patents and is vice president for refining, American Petroleum Institute. He is also a member of the Chamber of Commerce and the Board of Trade of Philadelphia as well as Franklin Institute and social and civic groups.

The accompanying article is based on remarks of Mr. Thayer before the Wilmington, Del., Chapter of the Society For The Advancement of Management.

The Sarnia Plan

We sought to do this when in 1952 the Sun organization commenced construction of a small oil refinery at Sarnia, Ontario, to supply our rapidly growing Canadian market. The design capacity was 15,000 barrels a day. Because of this extremely small capacity we were faced with extraordinary demands for economy in order to be able to operate competitively with larger refineries. We believed that by a high degree of automation, coupled with an organization to match, we could keep out of trouble on costs. So the planning of the processing units and controls was accompanied by the designing of a staffing plan, later to become known as the "Sarnia Plan."

Physically, the refinery was laid out so that a single crew working as a unit could operate and control the entire refinery from one spot, *Fig.* 1. From an organization standpoint, we broke with just about every practice and tradition that had

grown up in the oil refining industry. These practices and traditions had grown up under conditions vastly different from those which exist today. We struck out on a new approach. Only with the complete and willing co-operation of all employees, working with management as a unit, could the plan succeed.

In this refinery, all the men except the accountants and lab technicians are part of a single operating team. There is only one department—the Operating Department. The men were trained somewhat as the crew of a submarine, in that every man can fill almost any breach. They are not concerned whether someone is doing their work, or whether they are doing someone else's work. Their interest lies, as a team, in keeping the refinery in operation. All of the operating work is their work. There are ten men on each shift. They run the entire refinery, including crude distillation, catalytic cracking and reforming, product testing, blending and shipping of products, and the utilities.

Maintenance of the refinery is handled by an outside contractor. If we attempted to do our own maintenance work, there would always be either a feast or a famine in manpower because of the refinery's small size. The contractor, on the other hand, balances his employment by supplying maintenance people to a number of various plants in the Sarnia area. The refinery calls in each day the number of men needed for the maintenance work involved.

▶ Getting Team Effort

One might ask, "How do you get the operators to do all that work?" First of all, I should point out that none of them is overworked. The question would really mean, "How do you get the operators to do all those different *kinds* of work?" and would be asked because of the rigid divisions of labor and craft lines that are more normally encountered in industry today.

Here, I believe, are the essential parts of our answer: First, the people for this new refinery were carefully selected. Previous refinery experience was not a requisite. We were more interested in basic intelligence, vision, and drive.

Second, at Sarnia we provided a scheme which we thought would appeal to good, conscientious people with a reasonable amount of ambition. Every employee is on the salary payroll; there are no hourly workers. As is the case with most salaried jobs, there is a salary range for each classification so that a man can move up in salary without necessarily being promoted. In other words, it is a merit system.

In most of industry, a new appointee to a particular classification draws the same hourly wage as a man with say 20 years of experience in that classification. At Sarnia, the employee of long service will undoubtedly be at or near the top of his salary bracket and a new man with less experience will come in at the bottom of the bracket. We know that this is a factor in employee satisfaction because it recognizes experience and knowledge. Moreover, the merit system provides an opportunity to reward exceptional performance.

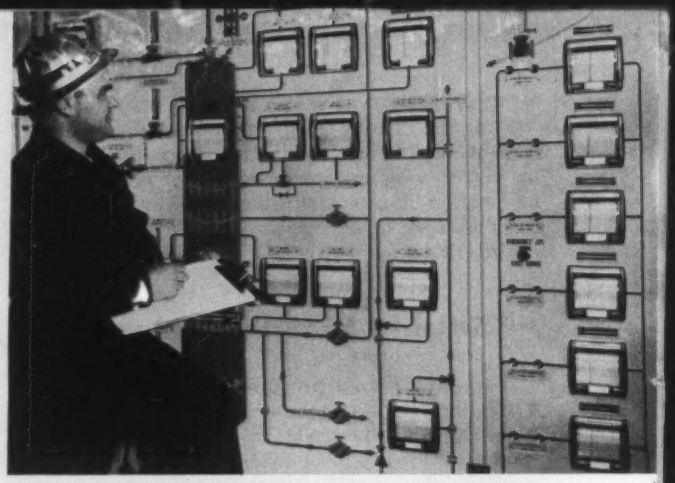


Fig. 1—Centralized control panel shown allows control of Sarnia, Ontario, refinery from one location. Since the refinery was considered of extremely small capacity, management felt a high degree of automation and a specialized organization were required to compete with larger refineries. The staffing arrangement they developed became known as the "Sarnia Plan."

Third, we do not draw a line between supervision and nonsupervision. At Sarnia, each employee has under his control on the average, about a quarter of a million dollars worth of equipment, and since he in effect supervises this equipment, each employee could well be classed as a supervisor.

Fourth, in the Sarnia Plan we sought to recognize the dignity of man. We coined a completely new set of job titles. There are no *second class* or *third class* or *fourth class* people. There are no *helpers* and no *assistants*. There are no *trainees* and no *janitors* and for that matter no *foremen*. Since the employees at Sarnia have a wider scope of responsibility, the new titles they carry are not just empty words, and we believe the titles have some importance to the men—although probably not as much as the salary rate itself or the merit increase system.

The Sarnia refinery has been operating very successfully for five years. During this time there have been additions to the plant and changes in organization. They have proceeded without a hitch. Two years ago a chemical company with whom we co-operated began operating at Sarnia with a similar personnel arrangement. More recently this company has begun operation of a new plant using the same plan in California. They, as we, are highly pleased and particularly so since the men themselves have maintained their enthusiasm.

▶ The Problem of Updating Plants

Now, as I pointed out earlier, it is easier to design an automation system and an organization that release the full potential of man and machine when

you are dealing with a *brand-new* plant. All three plants using the Sarnia Plan started out new. The greater problem comes in introducing into existing plants the organizational changes that are necessary if automation is to pay for itself and return a profit. Yet it is this more difficult task that faces us increasingly in the future.

I am not sure that management generally appreciates the enormity of the change that has taken place in the nature of its problem of producing capital for plant replacement and renewal. In the oil refining industry, with which I am familiar, the boast was frequently heard 25 years ago that technological progress was so rapid that new plants were obsolete in seven years. This may not have been wholly true but certainly in many instances it was. It was common for an oil company to write off cracking plants and the like in seven years. Then corporate tax rates zoomed upward, accompanied by inflation. At the same time, the Internal Revenue Bureau required corporations to amortize their plants at a slower rate. Today, instead of writing off a cracking plant in seven years, an oil company is more likely to be required to accept a 12-year or longer write-off.

I have calculated that with a given percentage of net profit reinvested, and taking into account the present level of corporate taxes and inflation as expressed in the construction cost index, a plant which formerly could be replaced every seven years without new capital must henceforth give about 30 years of service. Obviously, this plant must be kept competitive with newly built plants during its entire physical life.

In manufacturing at Sun, we recognize this to be one of the major problems of our existence today. Unless conditions change, we see no escape for oil refineries from the necessity of constantly converting, altering and automating their plants to keep them operating competitively three to four times as long as they were accustomed to do 25 years ago. Scrapping an old plant and building a new, improved one may still make technical sense but it makes far less financial sense than once was the case. Along with almost constant changes in the physical plant needed to keep it competitive, changes in organization, personnel assignment, and working conditions will be essential. There will have to be as much planning ahead for one as for the other.

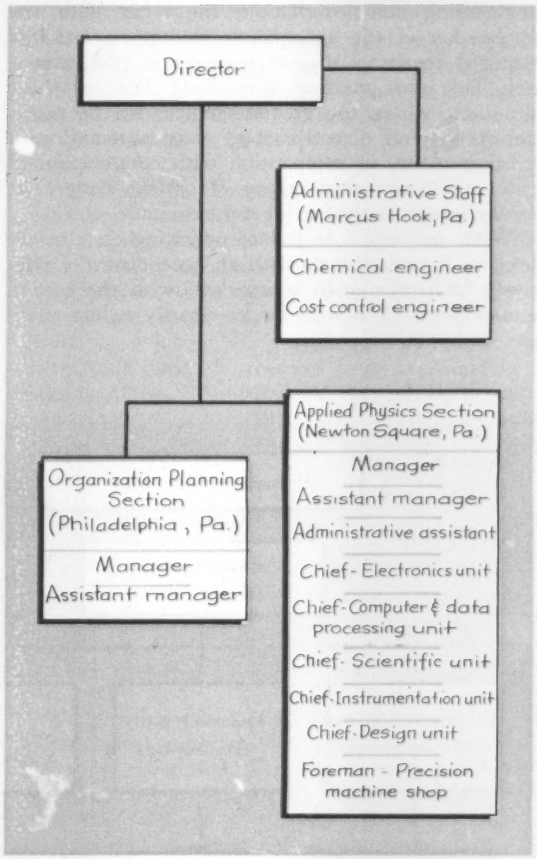


Fig. 2—To provide the basic planning required for future profits, Sun has established an Advanced Management and Methods Division organized as indicated by this block diagram. It is charged with studying operations, designing automation systems and the organizations required, assisting in installation, and evaluating results.

▶ Updating Employee Relationships

And more than planning will be involved. In my opinion management has been derelict in its responsibility to communicate with and inform the working man. I will go further and state that I believe management's greatest failure has been in the field of human relations. Some of the labor bosses have gained great advantage from this failure. We in industry are all guilty, to a greater or lesser degree, of being so preoccupied with the economics, the finances, the developments, the installations, and efficient operation that we have often failed to take our employees into our full confidence. We have neglected to appreciate fully the need for obtaining the understanding of our employees of the new circumstances dictated by the problems swooping down upon us. We haven't talked enough about our plans and what they mean to employees.

While some union leaders were busy persuading employees to resist every change, management in many plants permitted the problems to pile up until the accumulation of resulting inefficiency could be tolerated no longer. Then there came a labor upheaval, perhaps, or a complete shutdown or abandonment of a plant, or a reorganization in which hundreds or perhaps thousands of men were laid off. To me this reflects a previous—as well as current—failure of management, and surely the working man deserves a better deal than that.

In our company our objective is to keep our plants competitive, but to introduce advances in systems and organization on a schedule planned to avoid disruption and hardship to personnel. In a mature plant such as our Marcus Hook refinery,

we expect to bring improvements in existing units into being at a rate that will match our declining manpower requirement with the normal reduction in employment occasioned by retirement and other ordinary causes. In other words, our goal is to permit normal attrition to reduce the employment roll, and to time the installation of advanced methods to coincide accordingly, thus avoiding layoffs. Of course, we expect to create new opportunities for our people, and jobs for new people by the expansion of our business, necessitating new units and plants. We believe that in the right kind of an atmosphere, assuming we can gain the understanding and co-operation of employees with our objectives, we should have a far greater opportunity to accomplish increased productivity than will those managements who are far apart from their employees and who are in almost constant strife with them.

We look forward to constant change—in plants, organization, personnel assignment, and working conditions—as we seek to solve the problems imposed by new conditions such as I have outlined. Flexibility will be imperative. The continuous process of adaptation—by management, supervision and employees alike—can be accomplished only through understanding, agreement and co-operation on the part of all parties concerned. We do not believe this is an impossible goal by any means, for men are not such fools as to want to cling stubbornly to antiquated ideas and methods that are demonstrably against their own best interests.

▶ Planning Ahead

Several years ago we spent about $30 million at our Toledo, Ohio, refinery to build some new units and to modernize others. The capacity of the refinery was increased from about 45,000 to 95,000 barrels a day. In addition to the increase in capacity, we obtained a better yield of higher-value products and the quality of products was very considerably improved.

After completion of the new units, there were about the same number of people on the payroll to run 95,000 barrels a day as there had been when the refinery ran 45,000 barrels. Of course, the new units were more automatic than their predecessors. We felt we had done a good job, and there was some tendency to look upon it as a completed job.

Recently, however, one of our competitors, who was familiar with our Sarnia refinery and its organization, completed construction of a new centralized plant with a capacity of about 60,000 barrels a day. His plant, we find, will operate with substantially less manpower per unit of capacity than we have at Toledo. In fact, it matches our Sarnia refinery. Thus, it is clear that in a period of about seven years a capability of just about doubling production per man employed has become feasible. As long as this capability exists someone is going to take advantage of it, and that someone is likely to be a competitor.

For the reasons I have already reviewed, it is not probable that the oil refining industry is going to be shaken up by the sudden construction of a large number of new, highly-automated plants. But, as competitive as the oil industry is, it doesn't take a lot of new plants to shake it up; just a few are enough to touch off the scramble.

Of course, we may, ourselves, turn out to be one of the few, depending on the need and the funds available. But our primary objective is to bring our older plants up to a point of efficiency, through automation and reorganization, that will enable them to compete effectively with the new ones. To that end we have recently established within the Manufacturing Department an entirely new organization known as the Advanced Management and Methods Division, *Fig.* 2 and 3. It is charged with responsibility for studying refinery operations, designing automation systems and the organization required to operate them, assisting in their installation, and, finally, conducting necessary evaluations of the results. The division consists of two sections, one dealing with the development and design of automation equipment and instrument engineering and installation, the other with the application of the automation equipment and the required reorganization of supervision and personnel. This new division is working first on those situations where the greatest return can be made, but its general objective is to place automation of existing plants in competition with construction of new plants or other means of cutting costs. The most effective method will get the capital.

What we seek is to reduce operating costs to the level of a new refinery with an expenditure of relatively little money in comparison with the cost of a new plant. We will not necessarily reduce man-

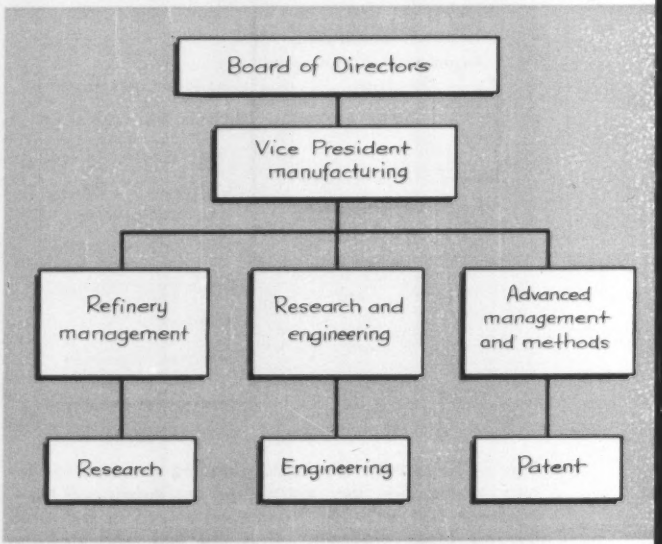


Fig. 3—Relationship of the Advanced Management and Methods Division to other parts of the company is shown by this line diagram.

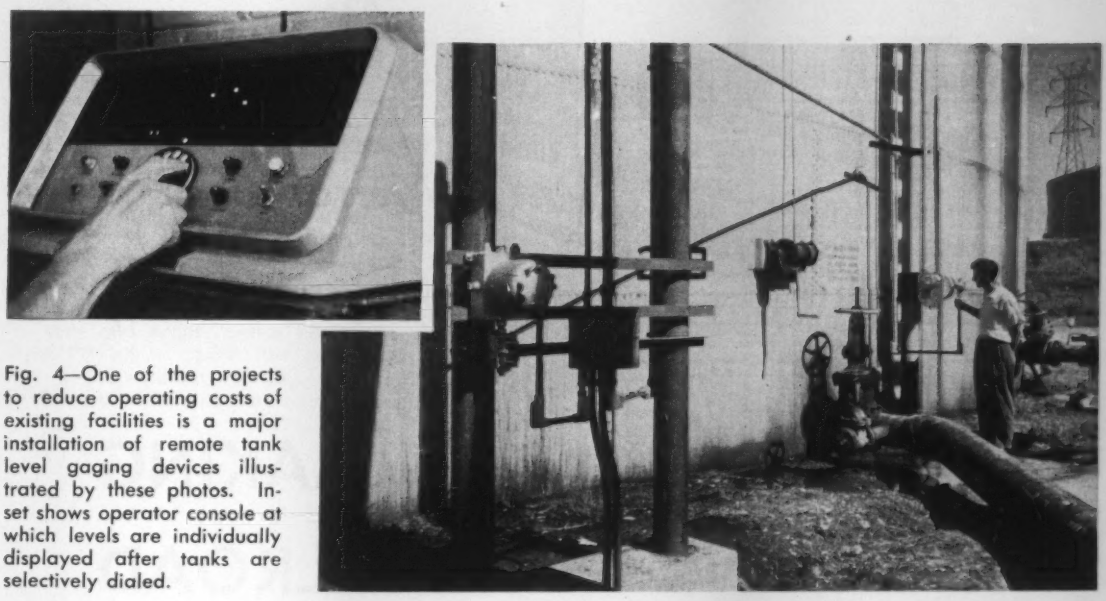


Fig. 4—One of the projects to reduce operating costs of existing facilities is a major installation of remote tank level gaging devices illustrated by these photos. Inset shows operator console at which levels are individually displayed after tanks are selectively dialed.

power to the requirements of a brand new refinery—such, in fact, may well be impossible. But, with lower fixed charges than would be involved if the improved plants were new at today's prices, we can tolerate a larger payroll and still operate competitively.

While we are organized for the task, and have plans and ideas, there is a lot of expectation, or hope, in the objectives I have described. Our program is only months old at this time. One of its early projects is a major installation of remote-control tank gaging devices, *Fig.* 4. These devices, linked to a computer, provide information in two hours that normally requires from 10 hours to 15 days to obtain. Meanwhile, a great deal of experimentation has taken place in other areas of quantity control, quality control, and plant efficiency.

▶ Future Job Opportunities

Our greatest difficulty, as I am sure will be true in the case of all manufacturers, will come in winning employee understanding, acceptance, and cooperation in the changes in personnel practices and customs that will be required to make automation effective.

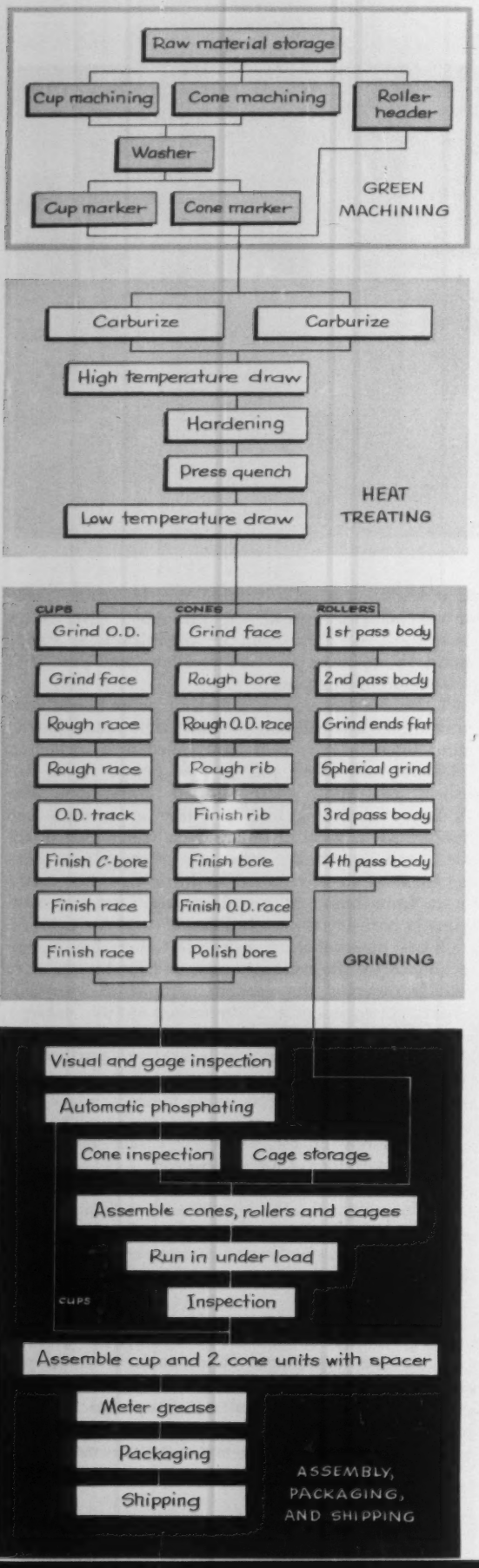
Workers have historically resisted invention and technological progress since the beginning of the industrial revolution. Despite the riots and wreckage of machines, however, technology has marched forward. Now, however, we are in an age of acknowledged political ambition and power of some unions whose leaders admit that their battleground is the legislative chamber. Will resistance to advanced methods of production be translated into political action and come to have the support of the absolute power of government? Labor leaders could challenge me to produce evidence that they have opposed automation. I would have to admit that few have attacked automation by name. Their attack centers, instead, on just about everything that must be done from an organizational standpoint to make automation possible, and thus it is even more devastating.

If you have a leak in a water pipe at home, your inclination is to call in a plumber. If he observes strict craft lines, he may well have called in a carpenter, plasterer, tile-setter and painter before he is finished. You know what the bill would look like. Industry is footing bills like that every day—and footing them without point. Even when men qualified to do a job are available in the plant, management often is required to bring in other craftsmen from home at premium pay rates for overtime or part-day work schedules.

Blind observance of strict craft lines has a consequence for the working man, and for his children, which deserves the earnest thought of everyone. That consequence is a limitation on job enlargement and opportunity. If work is to be divided into narrow specializations which are not justified by the depth of knowledge or degree of skill involved, a rigid pattern is imposed upon industry which may long into the future restrict personal opportunity. The children of today's workers will move into industry with jobs of limited horizon.

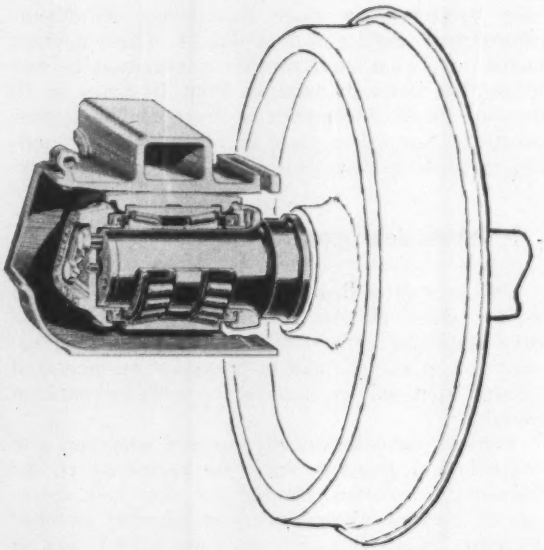
The age of automation demands broad talents and flexibility. Yet the rigidities of custom and tradition are being fought for tooth and nail by those who lack understanding or interest in the true welfare of the working man—in his progress and in his opportunity.

How much better it would be to permit progress in human occupation to accompany progress in machine technology! How much better to permit types of jobs to come into being that challenge and utilize man's full talents! There lies the road to advancement for individuals in self-fulfillment, self-development, income, and dignity in occupation.



AUTOMATION TODAY

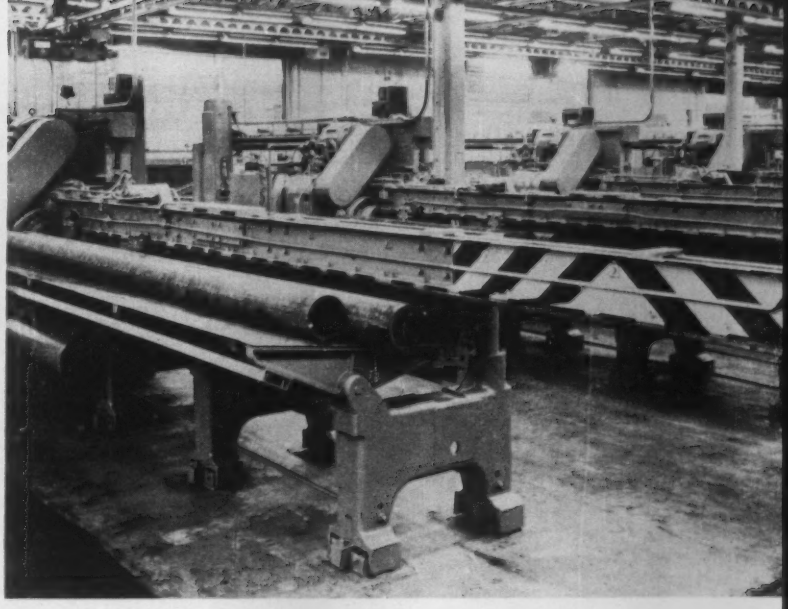
MAKING RAILROAD ROLLER BEARINGS



1

Flow diagram shows the manufacturing process for making railroad tapered roller bearings. The production line is installed in two buildings—one building houses the green machining and heat treating units, and the second building encompasses the grinding, assembly, and packaging lines.

2



Manufacture of railroad roller bearings starts on the green machining line at Timken Roller Bearing Co. Bearing cups and cones are machined from seamless tubing on five single spindle automatic screw machines built by National Acme Co. Using seven tools, the screw machines turn, bore, and cut off the cup and the cone pieces. Automatic handling devices then move the green pieces to five National Acme Chuckmatics which machine the cutoff ends of the cups and cones. After being conveyed through a washer, the cones and cups enter separate marking machines which stamp identifying data on the parts.

OVER THIRTY YEARS of research and development preceded the building of a new railroad tapered roller bearing production line at the Columbus, Ohio, plant of the Timken Roller Bearing Co. This experience dates back to the first application of Timken bearings on railroad cars for the Wheeling and Lake Erie Railroad, now a division of the Nickel Plate Railroad. Since that date, the demand for roller bearings has grown to a point where 20,000 car sets of bearings are needed a year.

Today, over 25,000 freight cars have been equipped with Timken roller bearings by 66 railroads and private car owners. The reasons the railroads have switched to roller bearings are savings realized from eliminating the hot box problem, and the reduction to a minimum of terminal bearing inspections, lubricants, maintenance, and routine inspection. An economic study has shown that when all railroads are equipped with roller bearings, the railroads will save an estimated $224 million each year, or $113 per equipped car.

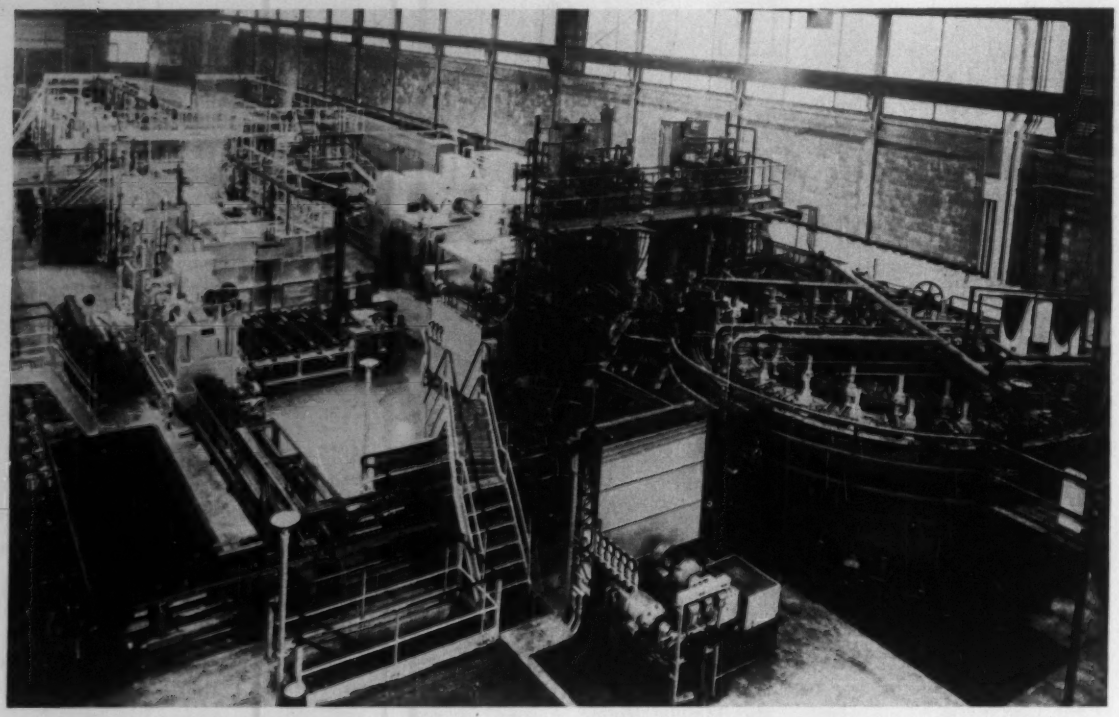
During 1957, friction bearing equipped freight cars averaged one hot box for every 189,000 miles traveled according to figures announced by the American Association of Railroads. This figure reports only those cars which are removed from trains as a result of hot boxes. It is estimated that the actual mileage per overheated bearing would be less than 50,000 miles per occurrence. Freight cars equipped with roller bearings average 75 million miles per overheated bearing.

To help meet a large future demand for tapered roller bearings, the Timken Company decided to build a railroad bearing production line capable of producing 20,000 sets of bearings per year. The experience gained in building the modern, highly mechanized Bucyrus plant* proved invaluable in solving the complexities offered by the new production line. Fundamentally, the concepts of the Bucyrus plant—which makes tapered roller bearings for industrial use—and the Columbus railroad bearing plant are the same. It was first necessary to persuade the railroad industry and other manufacturers of railroad bearings to standardize on bearing sizes. It was then necessary to sell the idea of roller freight so that demand and potential demand would justify the large outlay of capital necessary to set up a modern production line. Finally, the new facility had to be engineered to produce five standard sizes of railroad bearings at a price that would be attractive to the railroad industry.

To date, over $7 million has been invested in buildings and equipment for this plant. Two buildings, encompassing 200,000 square feet, house the production line. In the first building are located the green machining lines for making cups, cones, and rollers, and a complete heat treating department for carburizing, hardening, and drawing the green machined products. The second building houses three grinding lines—one for cones, one for cups, and the third for rollers—and inspection, assembly, and packaging lines. Mechanized handling is featured through the plant, and automatic gaging is used to feed back control information for machine tools.

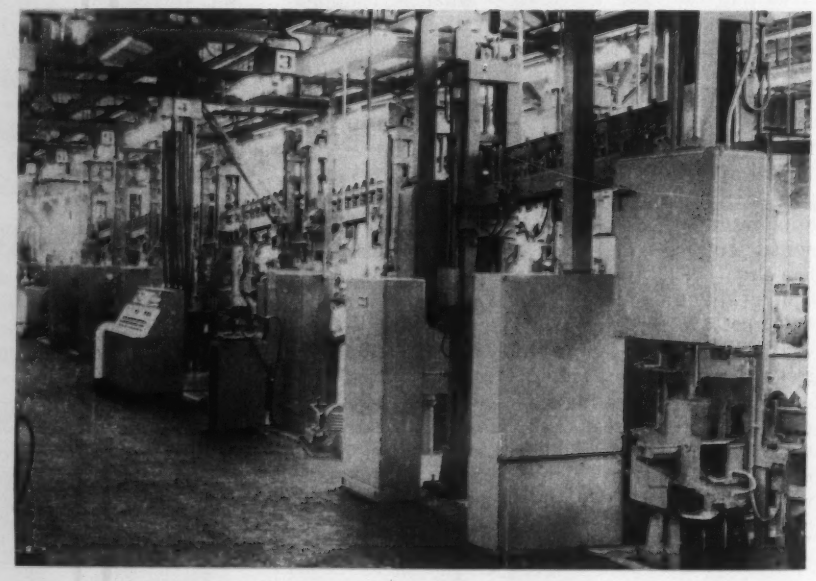
Seamless tubing, from which the bearing cups and cones are machined, is stored in a lot between the two buildings which house the production lines. Storage capacity of the lot is approximately one month's supply of tubes ranging in size from 6 to 10 inches outside diameter and 8 to 20 feet in length. The tubing is Krupp steel containing 3.5% nickel, 1.5% chrome, and 0.10% carbon. Tubing is transported to the green machining line by means of 6-ton capacity side lift trucks. Enough tubing is placed on the storage racks to stock the automatic screw machines for an 8-hour period. The accompanying illustrations show the manufacture of tapered roller bearings from this point forward.

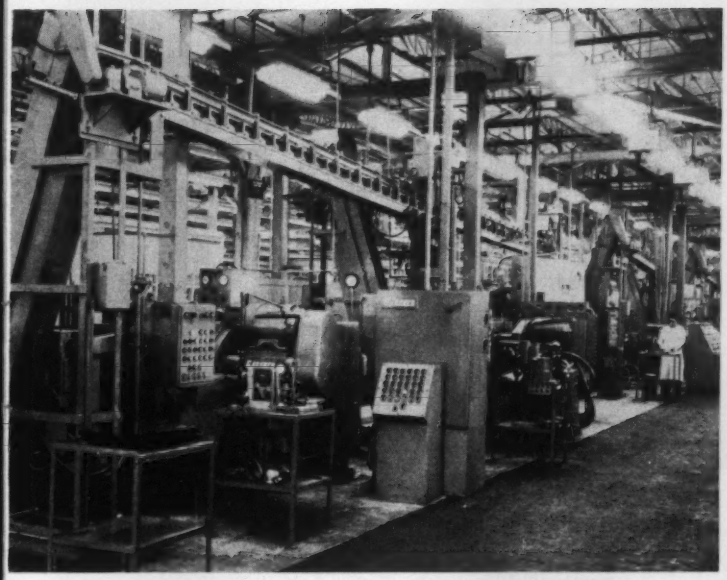
*"Making Tapered Roller Bearings," AUTOMATION, Vol. 5, No. 2, February 1958, pp. 57-62.



3 Bearing parts are next processed through four major heat treat operations. Starting at the left background of the picture, trays of parts remain approximately 23 hours at 1700 F in two side-by-side carburizing furnaces. After an oil quench, drain, wash, and dry, the trays enter a high temperature draw furnace, left foreground, for 6½ hours at 1100 F. Parts are again oil quenched, drained, washed, and dried and then enter a 44-position rotary hardening furnace, right foreground, for 1 3/5 hours at 1450 F. After a press quench, wash, and rinse, the case-hardened parts are processed through a low temperature draw furnace, center background. The complete heat treat unit, including furnaces, quench presses, and handling equipment was built by Surface Combustion Corp. When heat treating is completed, the parts are loaded on pallets for transfer to succeeding operations.

4 Heat treated cups are delivered to the cup grinding line on pallets and are manually loaded into a storage conveyor ahead of the first grinding operation. Eight separate operations are required to grind a cup on equipment furnished by Cincinnati Milling Machine Co., Gardner Machine Co., and Heald Machine Co. All cup grinding machines are equipped with gages which give in-process control at each operation. An automatic conveyor system provides handling and positioning of cups between operations and also allows 30-minute storage of parts. Washing stations in the bottom of each conveyor elevator clean and cool the cups after each operation.





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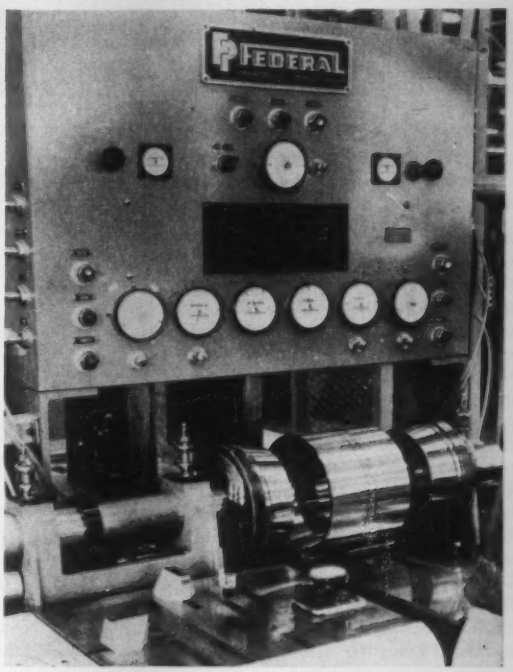
Heat treated cones reach the cone grinding line on pallets and are manually loaded ahead of the first grinding operation. Cones are ground in six operations on machines built by Cincinnati Milling Machine Co., Gardner Machine Co., and Heald Machine Co. Equipment for in-process gaging and for parts handling between machines is similar to that used on the cup grinding line. A monitoring panel and an overhead light system provide a means for operators to know at all times the operating condition of any station in the line.



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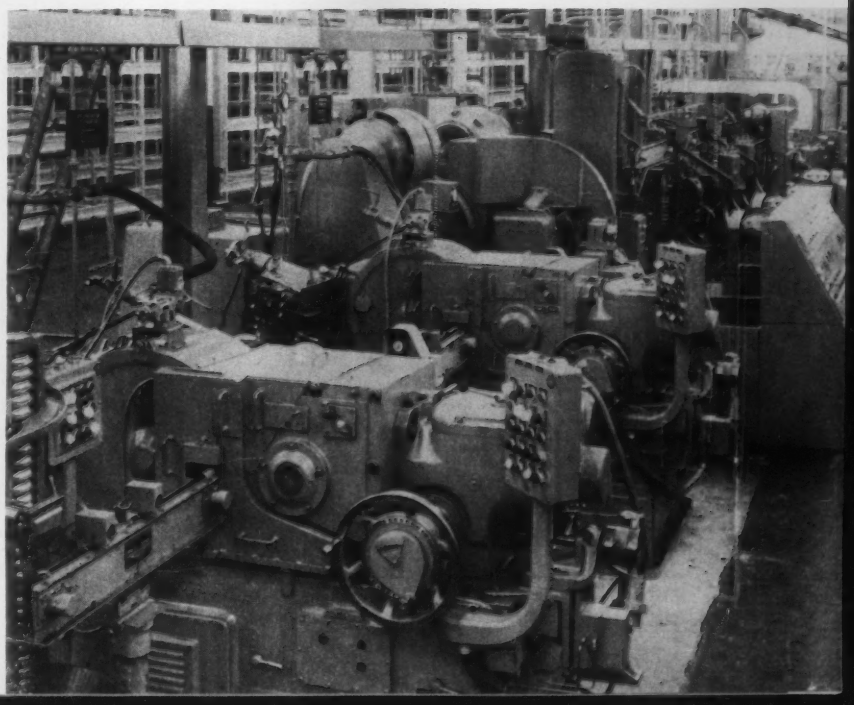
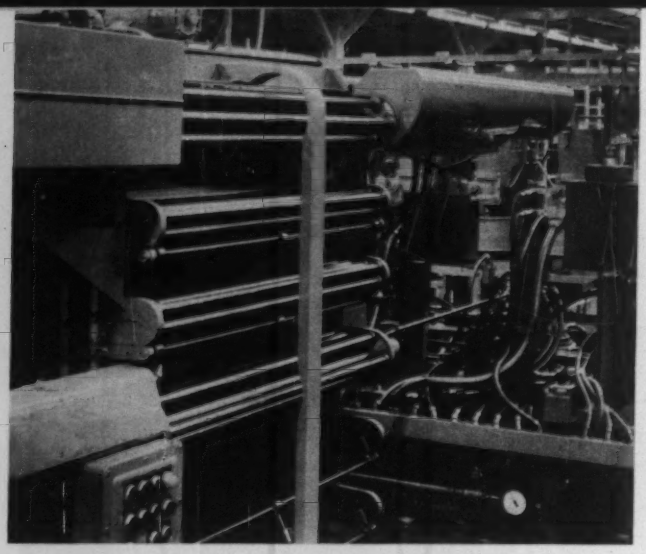
Cups and cones are conveyed from the grinding lines to inspection stations where each part is inspected for visual defects and is gaged for dimensional accuracy. A Federal Products Corp. automatic air-gage simultaneously checks the stand, taper, and counterbore diameters of each end of a finished ground cup. When the dimensions are within tolerances, the part is demagnetized and etched with a serial number. The number provides a means of checking the cup when it is in the field.

7

While cups and cones are being ground on other lines, heat treated rollers are processed through six operations on the roller grinding line. Equipment on this line consists of Cincinnati, Gardner, and four Timken designed grinders. The machines are automatically loaded by conveyors which are exactly timed for proper sequence. Gages are installed in the conveyor lines to check roller size and length. This information is automatically fed back to the grinders for wheel wear compensation.





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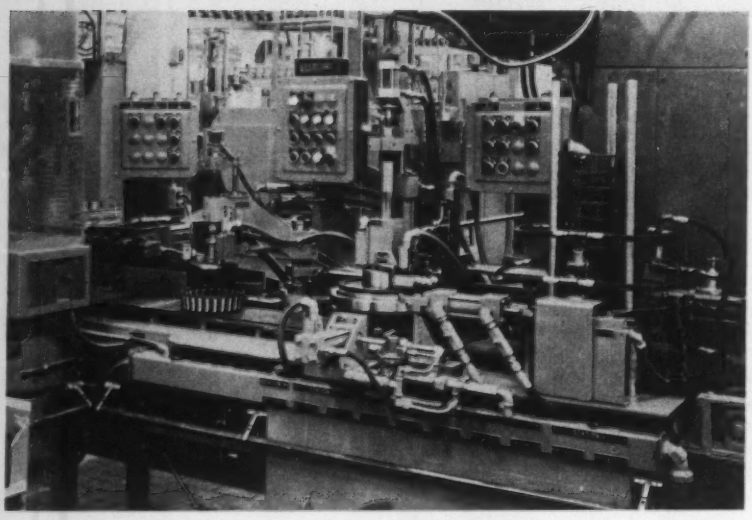
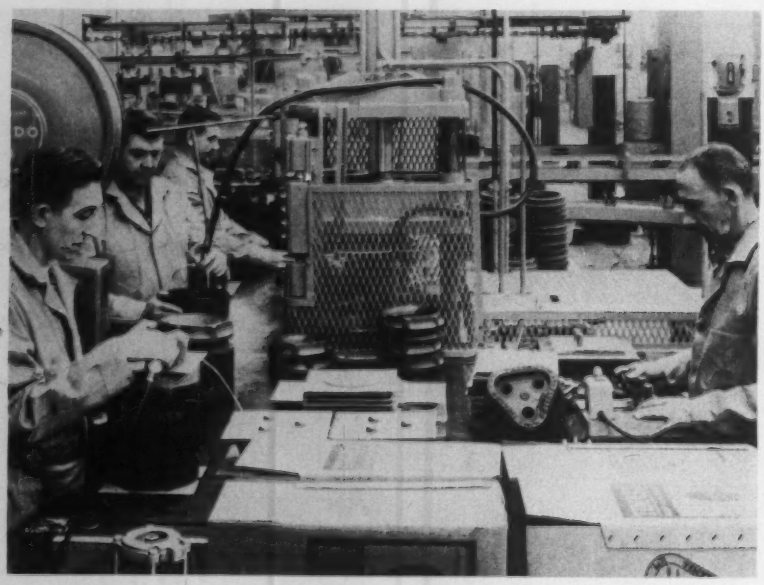
Following photoelectric surface inspection, rollers are conveyed to a roller storage machine. Enough rollers for one cone assembly are stored in each horizontal tube. They enter the tube in the same sequence in which they were ground so that all rollers in a bearing are as uniform as possible. As a tube is filled, the machine indexes, and an empty tube is presented for loading. The filled tube then gradually rolls down a serpentine track until it reaches a point where the rollers are ejected into a chute leading to the cone assembly machine.

9

After the cups and cones have been conveyed through an automatic phosphating operation providing a protective coating against rust, the cones, rollers, and cages are brought together and automatically assembled. In four basic steps the cone assembly machine places rollers in the cages, checks that all rollers are in place, places the cone inside the rollers and cage, and closes the entire assembly. Assembled cones are then conveyed to a battery of machines where they are run in under load. During this operation, the cone is flushed with filtered oil to ensure that all foreign matter has been removed from the assembly.





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At the final assembly station one cup and two cones are assembled with a spacer of known length, and the unit is checked for lateral clearance on a rotating air-operated fixture. Following this operation, the standard spacer is replaced with a production spacer as indicated by the lateral check. A metered amount of grease is added, and grease seals are pressed into the cup. Seal wear rings, cone backing rings, and axle end caps are then banded to the assembly with protective paper board, and the unit is placed in a box and sealed for shipment.

LOAD CELLS AUTOMATE SOAP BATCHING

CLOSE CONTROL of concentration of soap solutions used in making synthetic rubber is accomplished automatically in a batching installation at the copolymer plant of Phillips Chemical Co. in Borger, Texas. The reaction that produces the rubber occurs in an emulsion formed by agitating two monomers in the soap solution.

Weighing of a soap solution batch is obtained through use of Baldwin-Lima-Hamilton Corp. load cells that support a mixing tank, *Fig.* 1. The tank is equipped with a motor-driven agitator, and is serviced by water and steam lines. A weighing hopper feeds dry chemicals into the tank as required.

Sequencing of operations in the preparation of a batch is regulated from a control station, *Fig.* 2. This unit, located approximately 50 feet from the mixing tank, contains a continuous strip recorder that charts the weight and time period of each operational cycle and automatic and manual controls for each stage in the process. Sequence controls determine the order in which the process steps will occur, and weight control dials associated with each ingredient are preset to desired weights.

Mixing, checking, and correcting are performed in 10 steps as follows:

1. A caustic solution is added to the tank by manual operation of a valve.

2. Water and steam are automatically released into the tank, and their weights recorded.

3. Resin acid soap is added. During this process the controller starts an agitator that operates until nearly all of the desired quantity of soap has been added to the tank. When the agitator stops, the final increment of soap is added at a slower rate. This procedure insures that the proper amount of soap will be admitted to the tank.

4. The agitator is operated for a predetermined time period controlled by a timer.

5. Water at line temperature is added to the tank. The agitator operates during this process and stops just before the final quantity is added so that an accurate weighing can be obtained.

6. Two types of dry chemicals are weighed sequentially in a weigh hopper.

7. The agitator is started and the weigh hopper opens, admitting the dry chemicals into the mixing tank. The agitator continues to operate for a fixed time cycle and then is stopped automatically.

8. When mixing is completed, the controller stops the equipment and holds it in a standby condition while a sample of the soap solution is withdrawn from the tank and analyzed in a laboratory.

9. If the laboratory report reveals a need for additional mixing or correction of ingredient quantities, these are accomplished by manual control of the agitator or manual additions to the tank. Reference may be made to a deviation recorder chart that indicates at the completion of each material-adding step whether the quantity added was over or underweight. If the batch analysis shows the batch to be acceptable, this step is omitted.

10. The soap batch is transferred to one of two storage tanks by means of a pump operated by a switch at the control station. Interlocks prevent starting of the pump if the storage tanks will not hold the entire batch.

Weighing accuracy achieved by using load cells is plus or minus 0.1 per cent. Prior to installing the system, the operation was performed by weighing the tank in its empty condition and as ingredients were added, using a beam-and-lever type weigh scale. The old procedure entailed the possibility of human error, and was not conducive to good housekeeping. A 10 per cent savings of cycle time, and negligible maintenance, are reported for the new system.

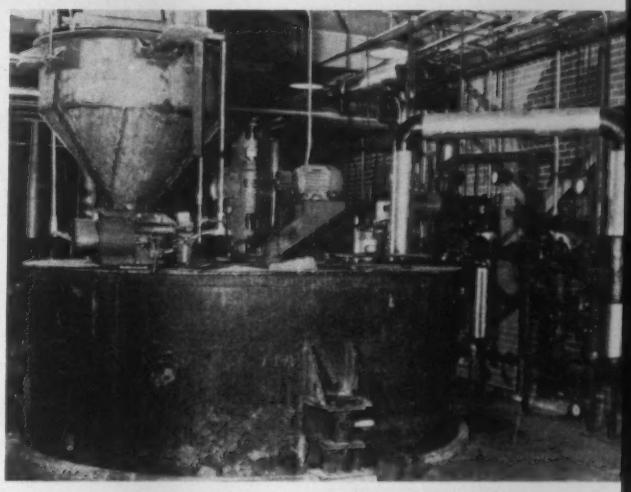


Fig. 1—Soap solutions used in manufacture of synthetic rubber are prepared in this tank. Chemical analysis of solution is critical, requiring automatic control of process to reduce possibility of human error in mixing ingredients.

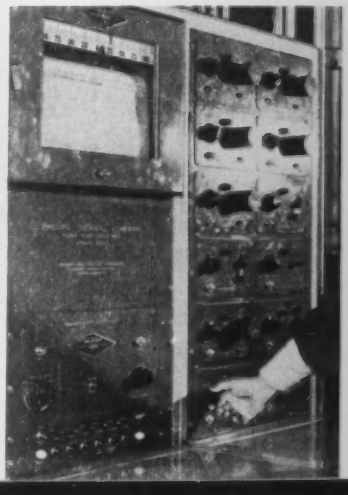


Fig. 2 — Control station built by Baldwin-Lima-Hamilton Corp. contains chart recorder that continuously follows progress of operations and individual sequencing controls that determine order of each step in process. Weight control dials are preset to desired weights of ingredients involved.

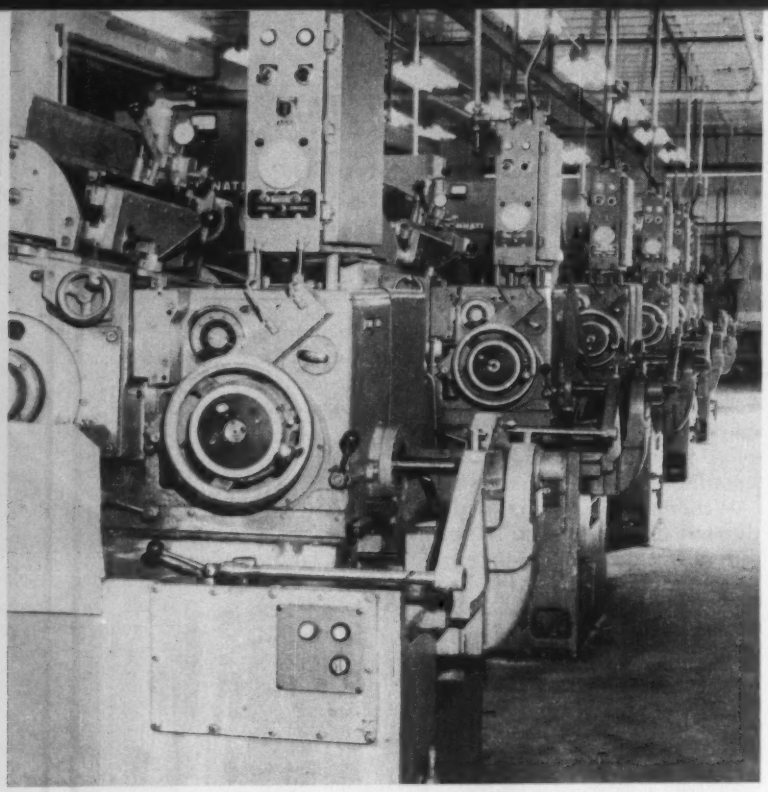


Fig. 1—Line using six thru-feed centerless grinders at Whirlpool Corp. has had control devices added to increase its productive efficiency. These include postprocess gages, grinding wheel slide compensators, and the necessary electrical and pneumatic circuits to make each machine a complete, feedback controlled operation.

AUTOMATING CENTERLESS GRINDERS

WITH HANDLING AND CONTROL DEVICES

By J. LLEWELL JESSUP
President, JEDCO Inc., Cincinnati, Ohio

Production efficiency of many machine tools can be increased by incorporating automatic handling devices and by controlling tool position with feedback type gaging systems. This article outlines methods of providing automatic operation on several different types of centerless grinders.

IN THE QUEST for increased production at lower unit costs, industry is installing more and more automatic machinery which combines into one integrated package the three key interests in automation—work performance, handling, and control. Machine tool builders have reacted to this demand by producing more automatic machinery and "specially engineered" machine tools which can be operated as separate automated units or be integrated into an automatic production line. Other companies have concentrated their efforts in designing and/or building work handling and control devices for automatic cycling standard machine tools that generally have only work performing capabilities. Such a company is JEDCO Inc. who recently completed a program at the St. Joseph Div. of Whirlpool Corp. to automate three centerless grind-

ing operations—one is a thru-feed and the other two are infeed operations. A study of the automation techniques employed in this program is presented as a guide for companies who may have similar equipment requiring upgrading or are contemplating purchasing new equipment with up-to-date work handling and control equipment.

Thru-Feed Centerless Grinding

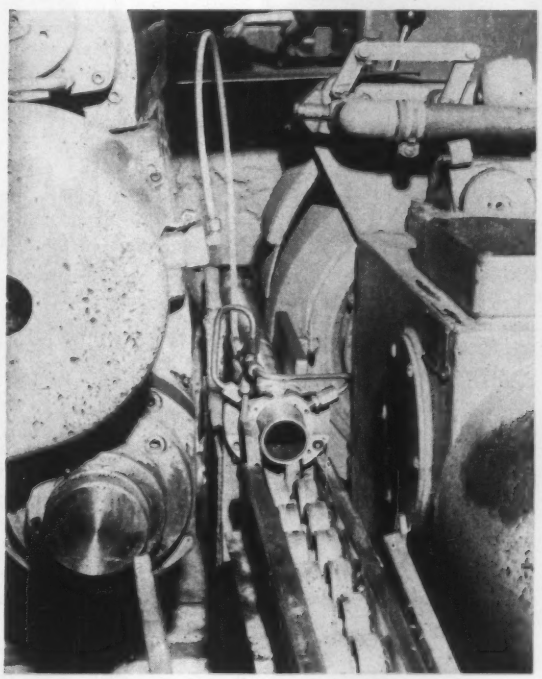
Automatic loading of a thru-feed centerless grinding operation is inherently simple because the geometry of the parts allow them to be loaded on one side of the grinding wheel, pass between the grinding face and regulating wheel during grinding, and unloaded on the other side of the grinding wheel. The only serious problem is one of automatically controlling the part size. This involves the measurement of part size by means of a postprocess gage and feeding back size signals to the drive units of the machine slides for corrections in size variations. There have been several excellent solutions to this problem, and a number of successful installations are in operation at this time. One problem confronting the potential buyer of this type of control equipment is that up to the present time major emphasis on size control has been placed on developing a feedback system that will control the machine within millionths of an inch but which must be sold for a price that is difficult to justify unless maintaining such tolerances is absolutely necessary.

Actually, much of the potential good to be realized from a size control feedback system on thru-feed grinding lies in roughing and semifinishing operations. On these operations the greater stock removal requires more frequent adjustment of the grinding wheel for wheel wear, and generally wider tolerances permit the use of a much less sophisticated mechanism for positioning the wheel slide. The same advantages also apply to finish grinding operations if exceedingly close tolerances are not required.

One of the three centerless grinding operations at Whirlpool Corp. consists of six thru-feed grinders, *Fig.* 1, which are used to finish center support tubes. They have been equipped with postprocess gages, compensators, and the necessary circuits to make each machine a complete, feedback controlled operation. Pneumatic type postprocess gages are used on the machines, and the gaging element, *Fig.* 2, is a three nozzle, open orifice gage ring. It is held in alignment with parts emerging from the grinding wheel by a clamp which permits easy removal during set up. The electrical and pneumatic control system for the gaging part of the grinder is installed in one panel to satisfy the maintenance department's requirements for environmental protection and easy servicing of components.

Infeed Centerless Grinding

A relatively new principle applied to the automation of centerless grinding is the control of the grinding operation by an inprocess gage. This principle is applicable to plunge grinding operations and is similar to that used in the gage control of grinding between centers. The purpose of the gage is to con-



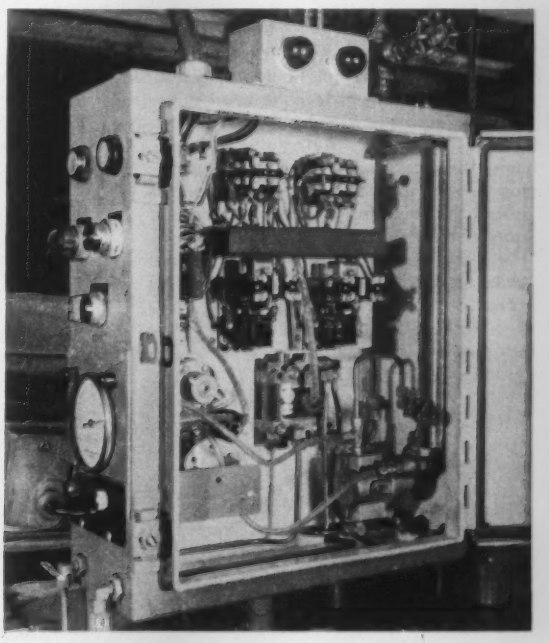


Fig. 2—Tubular part emerges from the grinding wheel of this thru-feed centerless grinder and passes through a 3-nozzle, open orifice gage ring where diameter measurements are picked up and fed back to machine control unit. Important control elements are grouped in one panel mounted on top of the grinder for accessibility to the operator and ease of maintenance.

trol the size of the workpiece independently of any variations resulting from wheel wear or from thermal distortions of the machine elements.

An infeed centerless grinder that has been automated is shown in *Fig.* 3. This has been done by adding an automatic loader-unloader fixture, an automatic infeed device, a three-station gage control, and an automatic slide compensator to a standard machine. The part finished on this grinder is a pinion shaft having three size conditions requiring gaging, *Fig.* 4. Although all three surface dimensions are gaged by separate gages, the grinding machine is capable of using only one gaging signal for slide position control. The other two gages are monitoring gages which are integrated into the electrical circuit to stop the machine and signal the operator if either gage measures an out-of-tolerance variation.

The gage controlling the grinding wheel slide is used on the diameter having the smallest tolerance and is arranged with two signal contacts. The first signal is obtained slightly above finish size and is used to trip the infeed attachment out of fast and into a slow feed rate. The second signal is used to retract the infeed attachment upon arriving at finish size.

The automatic grinding wheel infeed device incorporated in this machine is a standard commercial pneumatic feed unit that has been altered to provide a fast and slow infeed—a necessity with gage control. The unit is also provided with an overtravel limit switch which initiates a signal to operate an automatic slide compensator.

The automatic slide compensator is designed to maintain a constant infeed stroke by adjusting the retracted position of the grinding wheel slide as the grinding wheel wears or is dressed away. The compensator unit is mounted over the shaft of the manual slide adjusting handwheel and consists of a ratchet and pawl arrangement actuated by a pneumatic piston. During a normal grinding cycle, the infeed device advances until it is stopped by a signal from the inprocess control gage. As the wheel is worn or dressed away, the infeed must advance a greater distance to bring the work down to size. The limit switch of the infeed device is adjusted to allow the infeed to move over a normal length stroke without contacting the switch. As the wheel diameter decreases due to wear, the infeed device moves beyond its normal stroke and contacts the overtravel limit switch. This switch energizes a relay causing a set of its contacts to close. When the next grind cycle is initiated, an air valve is actuated by the closed relay contacts and feeds air to the pneumatic piston of the automatic slide compensator. The piston causes the manual slide adjusting handwheel shaft to rotate a predetermined increment through the pawl and ratchet arrangement and advances the grinding wheel slide to compensate for the infeed stroke overtravel. The amount of the predetermined infeed increment adjustment is determined by the number of ratchet teeth that will be

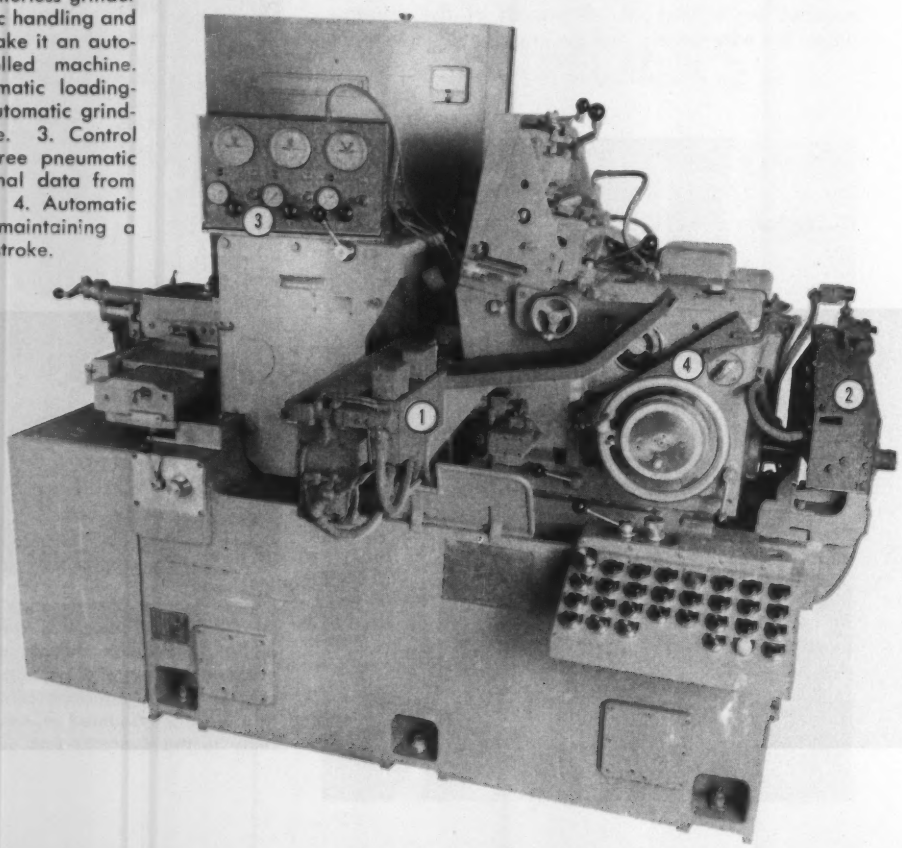


Fig. 3—Typical infeed centerless grinder shows the many automatic handling and control features which make it an automatic, feedback controlled machine. These include: 1. Automatic loading-unloading fixture. 2. Automatic grinding wheel infeed device. 3. Control panel for monitoring three pneumatic gages feeding dimensional data from the part being ground. 4. Automatic slide compensator for maintaining a constant length infeed stroke.

picked up by the pawl in the compensating device. Therefore, the next infeed grinding stroke is again equal to the normal stroke originally set up for the machine.

The automatic loader for the centerless grinder, *Fig.* 5, is a semistandard device designed for a typical configuration of part that is frequently ground on the machine. It is of unitized construction so that it may be removed as an assembly. By removing the fixture and "jumpering" a few electrical contacts in the panel, the machine may be returned to its original operating condition or a new fixture may be installed. The device consists of the following basic elements: A loading magazine which can be manually loaded with over thirty parts, or automatically loaded from a conveyor bringing the work to the machine from a prior operation; a shuttle for transferring the part from the preload position

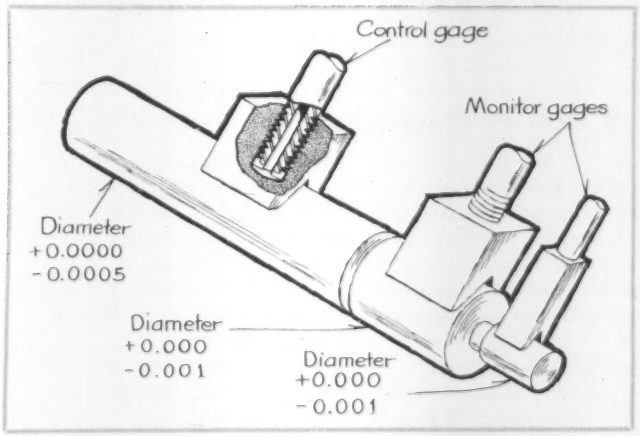


Fig. 4—Sketch shows the pinion shaft and the location of three pneumatic gages that control the operation of the infeed centerless grinder. Only one gage is active in the feedback control loop; the other two gages monitor grinding conditions on other surfaces of the pinion shaft and stop the machine when dimensions fall outside of tolerances.

to the load position; an injection and ejection mechanism; and a gage actuating mechanism.

In an automatic cycle a part is carried from the magazine to a preload position over the loading shuttle by the injector arm. At the same time, the previously loaded part is carried into the machine by the loading shuttle and injected between the grinding and the regulating wheels. As the injector reaches its forward position, the gage caliper is lowered onto the work, and the infeed cycle begins. During the grinding cycle, the injector arm is retracted from its forward position, and the loading shuttle returns to its home position where the next part drops from the preload position into the loading groove of the shuttle. Upon completion of the grinding cycle, the ground part is ejected from the grinding position into the unloading groove of the shuttle.

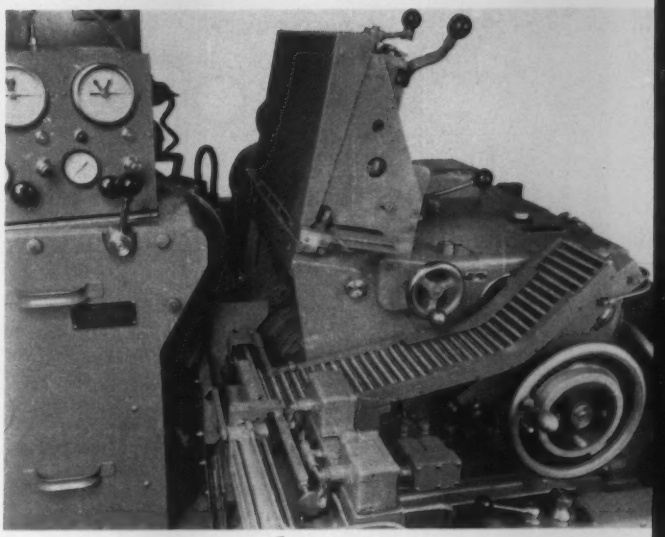


Fig. 5—Automatic loader-unloader for the pinion shaft grinder can be manually loaded with up to thirty parts or can be fed by a conveyor bringing parts from a prior operation. A shuttle unit in the loading device carries parts from magazine to the grinding wheel in the background. Upon completion of the grinding cycle, the shuttle unit removes parts from the wheels and drops them into an unloading chute.

The shuttle is then indexed to drop the finished part into an unloading chute and to bring the next unground part in line with the grinding position where it is injected between the wheels to start the next grinding cycle.

Since a gage controlled operation is dependent upon the signals received from the gage to properly program the infeed cycle, the machine should not be permitted to cycle without having a part in grinding position. Consequently, it is essential that the machine functions be interlocked to cycle only when there is a part in the magazine. In order to absolutely ensure the presence of a part, it is desirable that the part itself send a signal back to the electrical control circuit. Due to the fact that limit switches would restrict the flow of parts through the magazine, a commercially available pneumatic proximity transducer, developed by JEDCO, serves as a noncontact parts presence signaling device.

▶ Taper Infeed Centerless Grinding

The third centerless grinding operation that has been automated at Whirlpool Corp. is the grinding operation of a basket drive tube. The operation consists of plunge grinding a 0.001 inch/inch taper on 2 inches of one end of a 1 3/16 inch diameter by 18 inch long tube. The automatic loader provided for this operation, *Fig.* 6, is entirely special since the part is quite out of the ordinary in the type of operation that has to be performed. It consists of a magazine which receives the parts automatically from a prior operation, a two-stage injection device, an

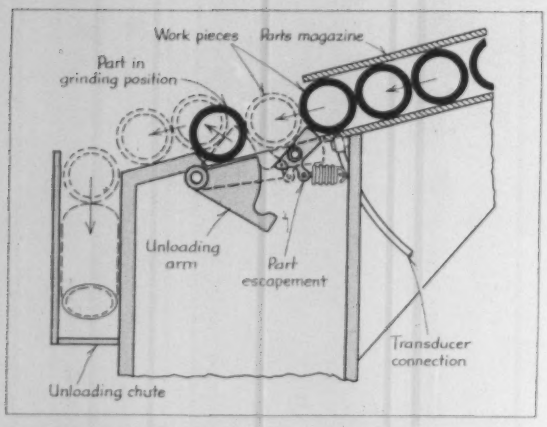


Fig. 6—Diagram shows the automatic loader designed for the taper infeed centerless grinders. It consists of a magazine, a 2-stage injection device, an ejecting cylinder, and a set of rollover type unloading fingers.

ejecting cylinder, and a set of rollover type unloading fingers. In order to grind a diameter over a 2 inch length on one end of a tube 18 inches long, it is necessary to support the outboard end in a V-support during the grind. Since the outside diameter of the part is finish ground before coming to this operation, all surfaces of the loader which contact the work are of a material that will not mar the finish. The existence of a part at the preload position in the magazine is signalled through a pneumatic proximity transducer.

The control gage on this machine is a standard single station gage equipped with a V-block type, open orifice gaging head and is supported between the wheels on a floating, spring-loaded mount. The loading of the part automatically positions the gage in the proper place to indicate the size on a preselected gage line of the taper. The automatic infeed device for the grinding wheel is the same commercial attachment that was used on the pinion shaft grinder and includes the modification for providing automatic slide compensation signals. The compensation device itself is also the same standard unit as was installed on both the infeed and thrufeed machines.

Providing Machine Modifications

When the problem of adding automatic devices to an existing machine presents itself, the natural inclination of the person responsible for the project is to request the original manufacturer of the machine to design and furnish the additional equipment. However, the engineering talent and manufacturing facilities required to provide special equipment on a standard machine can be tied up in producing the current machine line for the manufacturer and may not be readily available for special projects. Therefore, the original manufacturer of the machine to be automated may be reluctant to accept the special jobs.

Another factor that may cause the original manufacturer to be reluctant in supplying special equipment on an older machine is the problem of the machine guarantee. In many cases, the original machine guarantee may have expired when the request for additional equipment is made. However, if the manufacturer supplies new equipment under guarantee and both the original machine and the new equipment carry the same name, the buyer would not be inclined to limit the manufacturer's responsibility to the new equipment alone. All too frequently the manufacturer finds that he has reassumed a responsibility for an older machine which is equivalent to giving the customer a new machine guarantee. It is only natural that the machine manufacturer would wish to avoid the misunderstandings which could result from such a situation. Therefore, much of the work being done to automate standard machine tools is absorbed by small companies whose very existence depends upon their creative ability and their scope of understanding of the principles underlying the cycles and circuits of modern machine tools.

Economic Considerations

One point to consider when upgrading standard machine tools is that all tooling added to capital equipment—whether purchased as original equipment or supplied later—must be classified as expendable. The intense competition which presently exists in the consumer goods industries has resulted in a more frequent demand for model changes than has existed in the past. These changes have sharply accelerated the rate of obsolescense of special tooling. Therefore, the selection of elements to upgrade machinery should be made from versatile components that can be switched or slightly modified to accommodate model variations. Careful selection will hold down the cost of retooling for different models and extend the life of the special tooling. For example, in the Whirlpool Corp. modifications, most elements which were added to the grinders to make them automatic were standard units that are applicable to practically any type of part that can be ground on a centerless grinding machine. Any future tooling necessitated by the obsolescense of the current parts being ground will include only the mechanical elements of the loaders and gage actuators. With the exception of minor modifications required in the electrical circuits, all the standard units—such as gages, compensators, and infeed devices—can be used without alteration.

The problem of whether to continue operating existing facilities or to launch a large capital improvement program can only be resolved by a dollars-and-cents analysis. In the Whirlpool program, 75 per cent of the cost of the first installation was amortized in the first year of operation. Such results point up the desirability of upgrading existing machine tools to a level of production efficiency that will take advantage of advances in the technology of manufacturing.

INTEGRATED GRINDING LINE FINISHES INSULATION BRICKS

INSULATION BRICKS are widely used in industrial furnace construction as a backing for fireclay brick walls. Since insulation bricks have a heat insulating value as much as six times that of fireclay bricks, their use in furnaces can effect heat savings equal to those that would be obtained with a solid refractory wall many times as thick. However, these insulating values would not be realized if the insulating bricks were not manufactured to precise dimensions that ensure uniformity of size and squareness. This is accomplished by grinding the brick surfaces to close dimensional tolerances of 0.002 inch.

Gardner Machine Co. has developed a mechanized grinding line for finishing insulation bricks. The installation automatically grinds all six sides of a brick as it is processed through three conveyor-connected grinders, *Fig.* 1. The line is capable of finishing 2400-3000 bricks per hour and will handle two sizes of bricks—2½ x 4½ x 9 inches and 3 x 6¾ x 9 inches. Maximum stock removal from any one surface is ¼ inch.

The mechanized line is composed of three double-spindle disc grinders integrated by endless chain conveyor equipment. Unfinished bricks are loaded onto a chain conveyor, *Fig.* 2, which transports them, narrow side up, to a set of guide rails leading into the first grinder. At this point the bricks are contacted by cleats on a suspended chain conveyor, running transversely to the loading conveyor, and are pushed one-at-a-time through the initial grinding operation. As the bricks are pushed through the grinder, abrasive discs advance and grind each side of the brick until a micrometer stop is contacted and the desired amount of stock has been removed.

Between the first and second grinders the bricks are mechanically rotated 90 degrees so that a wide side of the brick is up. Cleats on a second suspended conveyor then contact the brick and move it on rails through the second grinding operation which face grinds the narrow sides of the brick. As the brick leaves this grinder, it is transferred to a third cleated conveyor which moves the brick to a transfer point where another 90 degree change of direction takes place. At this point a fourth cleated conveyor contacts the side of the brick and moves it through the last grinder where the ends are face ground. At the completion of this operation, all six surfaces of the brick have been ground, and the brick is removed from the line.

Grinding dust is removed from each grinder by an exhaust system. Each grinding wheel spindle is driven by its own 10 hp motor, and a separate 5 hp motor is provided for the conveyor system. The conveyor drive also has a variable speed feature permitting speed changes within the range of 2.75 to 1.

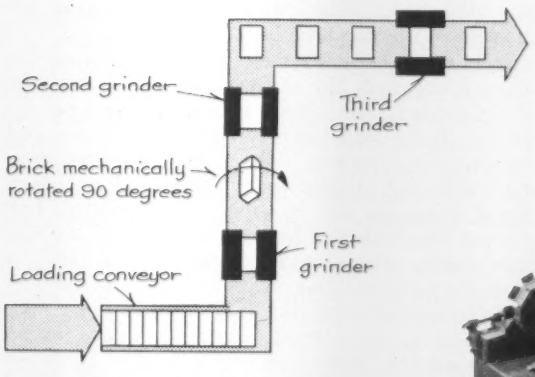


Fig. 1—Flow diagram shows the arrangement of three grinders that make up the Gardner Machine Co. integrated insulating brick grinding line. All six surfaces of the brick are face ground on the line which is capable of processing 2400-3000 bricks per hour.

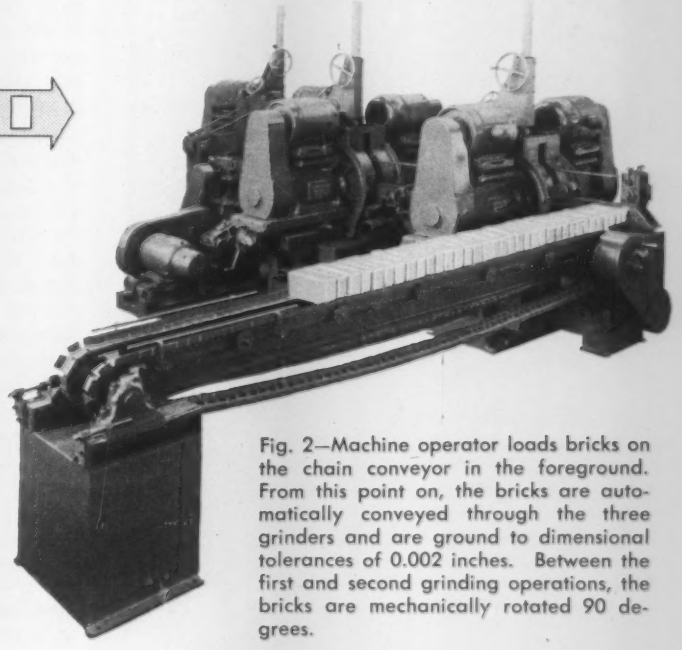


Fig. 2—Machine operator loads bricks on the chain conveyor in the foreground. From this point on, the bricks are automatically conveyed through the three grinders and are ground to dimensional tolerances of 0.002 inches. Between the first and second grinding operations, the bricks are mechanically rotated 90 degrees.

MULTISPINDLE TORQUING EQUIPMENT MECHANIZES ASSEMBLY OPERATIONS

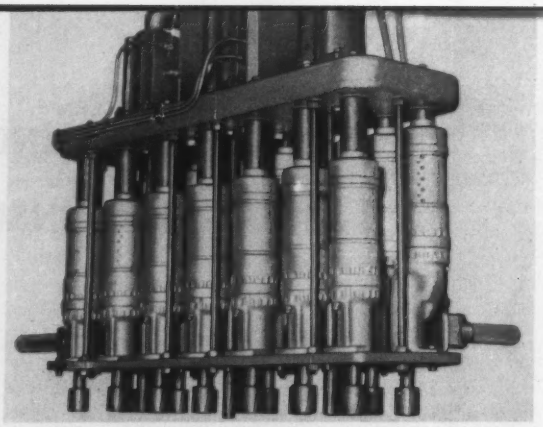


Fig. 1—Unit illustrates how components are combined to form a multiple assembly tool. Valving and individual tools are standard items. The tools are mounted between manifold, top of picture, and end plate which are joined by side rods. Manifold, end plate, and tie rods are specifically engineered for each application.

By **WALTER G. MITCHELL,** General Mgr. of Product Development, Thor Power Tool Co., Chicago, Ill.

POWERED hand tools for assembly operations, such as nut setting and screw driving, made their debut well before World War I. In the succeeding years improvements have followed, resulting in the advanced, automatic torquing units on machine tool type mountings that can be incorporated directly into the modern production line.

The improved forms of modern pneumatic multiple assembly units are made possible by the use of specially designed, clutchless, direct drive, regulated-air tools. With these units, the delivered torque is a function of air pressure. Uniform torque is obtained in operations such as nut setting by the stall-type action of the clutchless devices. A multiple unit is served by a single air line that terminates at a manifold, *Fig.* 1, which in turn supplies air at equal pressure to all tools in the unit. Desired pressure in the manifold is maintained by an air regulator connected in the air line. As a further refinement to obtain equalization and uniform torque in the output of individual tools in the multiple, each tool contains a compensating orifice-type regulator.

Collectively, the tools in a multiple unit use no more air than the same number of component tools would use individually. Multiples are frequently operated at regulated pressures as low as 40-50 psi, and almost always at 10-15 psi less than the pressure of the plant air line.

In multiple assembly tools, Thor Power Tool Co. offers a choice of five different sizes and capacities of air motors. The choice of unit depends on the nature of the load, arrangement of the tools, and specific torque required. Bolts, nuts, and screws ranging from sizes smaller than $\frac{1}{4}$-inch up to 1-inch thread diameters are currently being handled. Bolt spacing requirements that call for circular, in-line, rectangular, square, and arc patterns, as well as eccentric patterns, pose no problem. A unit employing offset spindles can set bolts at an absolute minimum of $\frac{7}{8}$ inch apart, center-to-center, on an in-line pattern. Extensions permit nuts to be driven

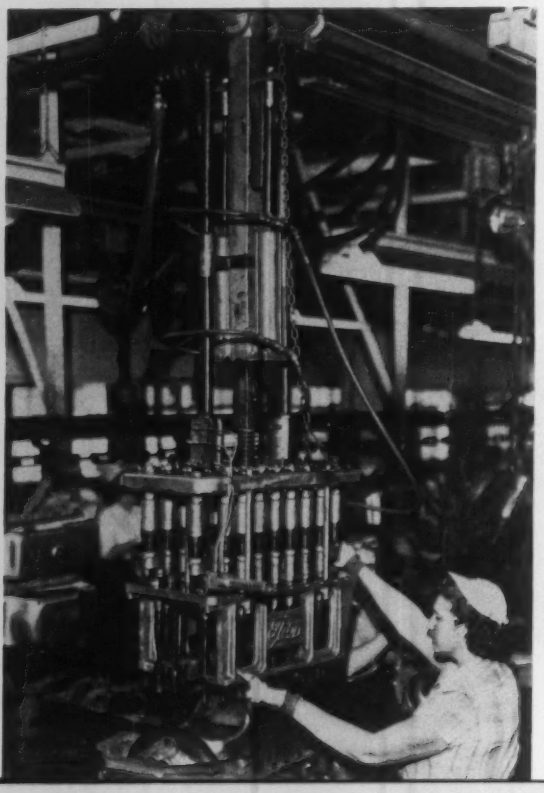


Fig. 2—Multiple unit can be held in fixed position over line of travel of conveyor as shown. The assembly is powered up and down by air cylinders under control of operator.

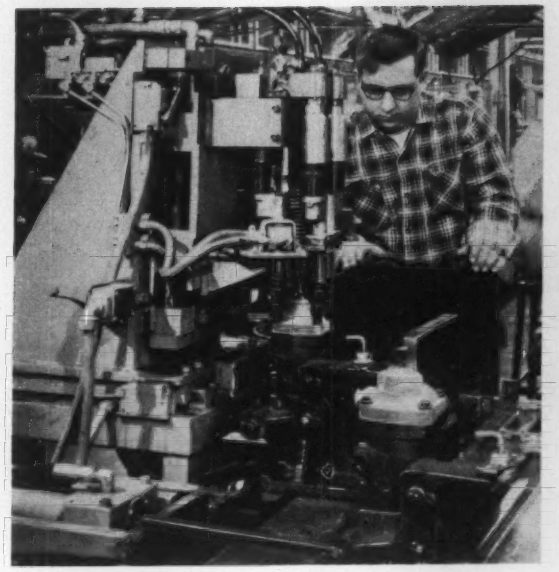


Fig. 3—Bolts on gear cover housing are driven by automatic four-spindle unit built into machine tool type fixture.

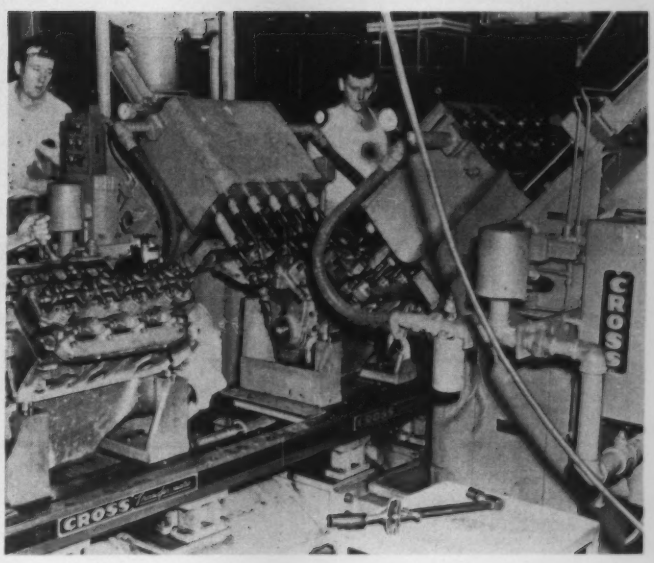


Fig. 4—Highly developed form of multiples in an assembly operation is typified by transfer line installation. Individual spindles can be replaced by withdrawing through the manifold.

from different heights or levels without sacrificing stability or power.

A multiple assembly unit is built-up from standard items, such as the pneumatic tools and valves, fitted together for specific assembly jobs by means of machined end plates, side rods, and the air manifold. A particular unit is not variable to different jobs, i.e., end plates, side rods, and the air manifold cannot be altered in form to fit another assembly. Adaptable designs would lack the rigidity and production capacity of present designs. However, since standard items are used in the assembly, the basic tools, controls, hoses, and valves can be fitted to new tasks when provided with new end plates and manifolds.

Multiples that are used in industry can be roughly grouped into either a hand-bench or automatic category. The hand-bench category, for example, refers to units suspended in a free-swinging, counterbalanced manner, attached to a powered telescoping mount, or bench mounted in stationary positions. In these types of systems, an operator positions either the work or the assembly tool and controls the operation, *Fig.* 2.

In the automatic category, manual operators are replaced with automatic feed, driving, and operating mechanisms and the units are mounted in automatic sliding and positioning machine tool type heads, *Fig.* 3 and 4. Typically, multiples of this type are put together by machine tool builders who design the installation around the capabilities of the individual units.

Where independently operatable tools are mounted together to form a unit, the problem arises as to how to replace individual tools in event of trouble. In the hand-bench category, a standard air entry connector-type mounting at the manifold permits the quick change of a tool without interfering with other tools in the unit. In the automatic equipment, a spool-type manifold mounting permits the removal of a tool through the manifold, without disturbing other tools.

The range of applications which have reduced costs in the automotive field extends from such operations as four-spindle units driving spark plugs up to 22-spindle units used in assembling oil pans. Should the nature of the job require it, as many as 36 spindles or more in a single unit would be efficient. The limiting factor is the size of the workpiece.

The most noteworthy recent advance in the field of automatic nut setting has been the introduction of a hydraulically-actuated system. Designed for operations involving critical torque requirements, the hydraulic unit simultaneously delivers uniform torque to as many fasteners as it is set to drive. Two stage hydraulic driving is used in the system. In the first stage, the hydraulic motors of the individual tools are effectively synchronized from a common pressure source and operated at relatively high speed (300 rpm) to obtain a fast rundown of threaded fasteners. In the second stage, the units hydraulically shift into torque synchronization at a lower speed (about 30 rpm), simultaneously delivering identical torque through each spindle until all spindles cease to move. At that instant, pressure is relieved and all fasteners have been tightened to the identical torque, with greater accuracy than is now achieved with production hand torque-wrenches.

Whatever system is applied, assembly problems involving torquing operations are susceptible to automation by techniques that recommend themselves to cost conscious production engineers.

TIME AND PRODUCTION RECORDER SYSTEM

PART 2

Following a previous article on the importance of error control in data processing, this concluding part of a two-article series is concerned with system design factors for successful data recording. What equipment is available? Who are the manufacturers? What points should be covered in an evaluation study?

EQUIPMENT EVALUATION FOR DATA INPUT SYSTEM DESIGN

By **ROGER L. SISSON**, Canning, Sisson and Associates, Los Angeles, Calif.

EXPERIENCE with mechanizing data recording indicates that it is a safe rule to try to design the recording process so that operating people are relieved of as much clerical work as possible. Let the machinist spend his time machining, and the salesman, selling! Where it is necessary for operating personnel to do some data recording, the procedures should be arranged so that as little data as possible need be recorded. The system should pick up any required remaining data later in the processing, if at all possible. The method of recording should promote accuracy and consume as little of the operator's time as possible (See Part 1—AUTOMATION, Dec. 1958).

In studying data input devices, the distinction between *preassigned* and *variable* fields should be kept in mind, as the method of recording the two will vary. A preassigned field, such as a shop order number, can be recorded by some sort of copying or transcribing device wherein the operator does not have to give attention to the particular number. A variable field, such as the quantity of items made, must be completely inserted by the operator, *Fig.* 1.

In a very few situations, the entire record can be preassigned. When a utility sends out bills, it can assume that for most of the payments the amount paid will be the amount billed. Therefore, at the cashier's input all that is needed is to see that the payment is for the amount billed and to enter the statement number, one of the preassigned field into the system. The customer number and the amount (also preassigned) are already available to the system.

But as a general rule it is not wise to predict variable fields, such as the number of items sold to a given customer, or the number of parts made at a given operation. Most businesses change too rapidly to permit the exact prediction of variable data. Therefore, an attempt to preassign it is of no use; conditions change by the time the data is to be recorded and everything becomes an exception. In other words, do not put special restrictions on an operation for the convenience of the data processing system, unless real benefits can be shown.

The most common method of reporting preassigned data is by prepunched tabulating cards. As a result of the wide use of tabulating equipment, such cards are inexpensive to prepare and easy to read. They fit directly into many data processing systems. Prepunched cards have some disadvantages, however; in particular there is no built-in redundancy in the card code or associated equipment (except the IBM 026 keypunch). However, redundancy may be added in the system, for example as a check digit, or as batch totals. Tabulating cards are often difficult to read mechanically if they are handled roughly, as they might be in a manufacturing shop.

Where both preassigned and variable data must be entered, there is some difficulty in associating the

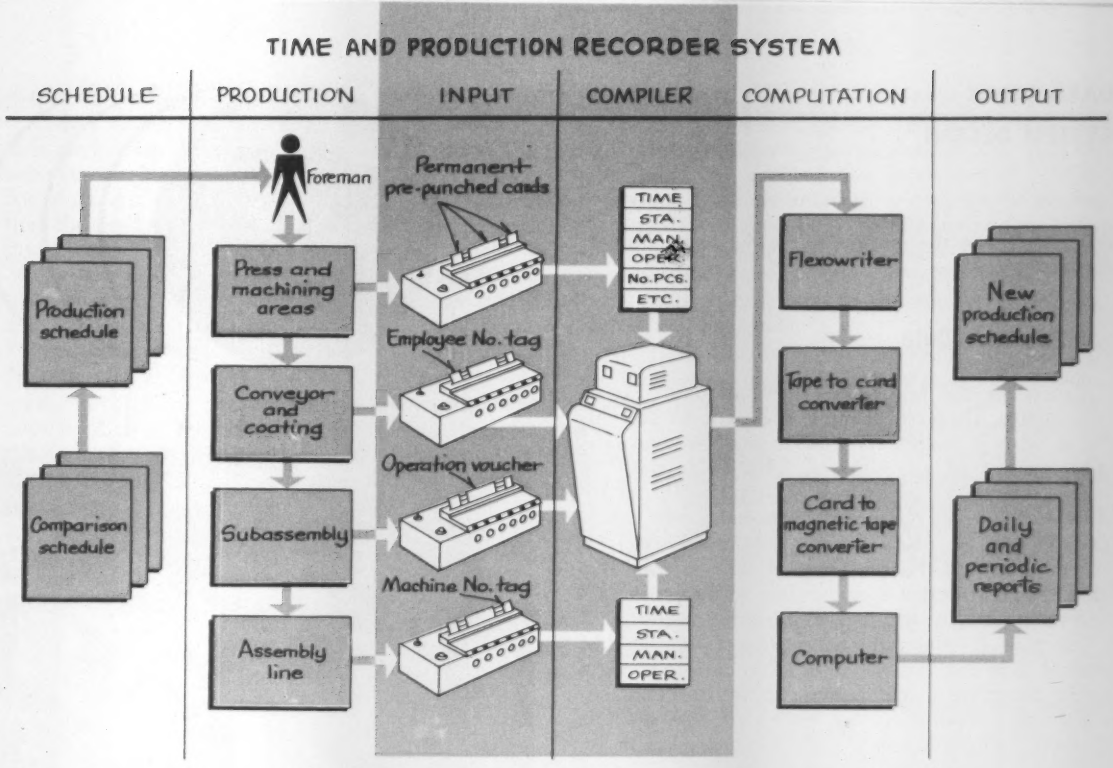


Fig. 1—Role of data input equipment in an advanced data processing system is illustrated. Adapted from information furnished by Stromberg Time Corp., the diagram begins with flow of information from daily production schedules to production floor. As operations terminate, permanent prepunched information is combined with manually inserted variable production information and processed by compiler. Paper tape punched by compiler is processed through computer, and new production schedules and other reports are prepared automatically.

variable data with the card. Often this data is handwritten and then keypunched onto the card; an expensive and time consuming process, especially if high accuracy is required.

Another form of entering preassigned data is with special badges, embossed cards, *Fig.* 2, punched garment or item tags, *Fig.* 3, coded shop order cards, etc. Garment tags have found use in department stores, where they save the sales clerk time and promote accuracy. The clerk merely tears the tag off and puts it in a box, which action records several fields of data. The tags are later converted to punched tabulating cards for processing. Similar tags could conceivably be used in stock rooms and shop data input systems, but no cases of such are known to the author.

The ideal method of reading preassigned numbers is to read them mechanically off the same form that the human requires for other purposes, for example, orders to direct his efforts. Such can be done with character readers, for example by a photoelectric system or a system employing magnetic ink. The American Banking Association has adopted magnetic ink as a standard. Some care must be taken in the quality of magnetic ink used and in the printing process. The magnetic ink has the advantage of

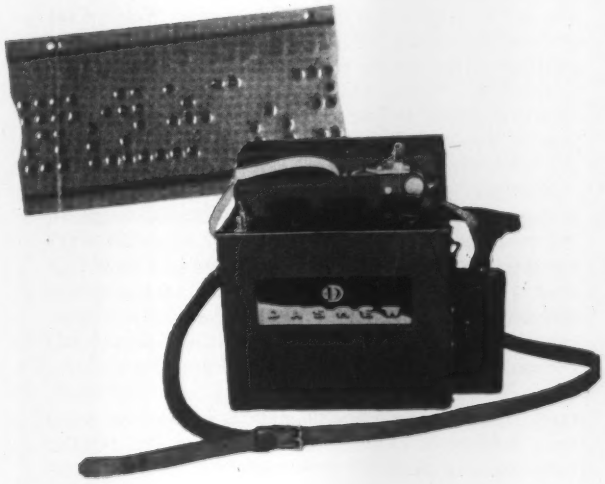


Fig. 2—Using embossed tags for preassigned data, this device by Dashew Business Machines Inc. translates coding on the card to punched paper tape. Size of unit permits it to be brought to the item to which a tag is attached, a useful feature for inventory taking.

being legible to the mechanical reader even through dirt and smudges.

Variable Data

Except in the few cases where all data can be preassigned, character reading devices must be combined with a method of introducing variable data. The method of recording variable fields must be carefully designed as there is no opportunity for redundancy checks (although reasonableness checks can usually be made in the data processing). It is, of course, in the recording of the variable data that special attention must be given to the procedures the operator is to use and training he receives.

Humans determine the magnitude of a variable by one of their five senses. The usual case is by sight as in observing a dial reading or by counting, but sometimes listening, feeling, tasting or even smelling is used. There are two ways a human has of recording or reporting his measurements: By some motion such as a hand or finger motion, or by speech. The recorder must communicate in some code and record on some medium. The code used almost exclusively is English letters with Arabic numbers. Sometimes arbitrary codes are created by use of check marks. The most common medium used is pencil or pen on paper. Unfortunately, recording in English Arabic code on paper generally results in a data unreadable by any machine, so that additional expensive human translation is required (it will be many years before an automatic handwriting reader is perfected). Thus the problem is to develop other methods of recording variable data—methods which eliminate the hand writing and therefore reduce the over-all cost.

Fig. 3—Preassigned data reader developed by National Cash Register Co. transfers information from punched tag to punched paper tape.

Fig. 4—Separation of reporting and recording functions is a useful concept in solving the problem of obtaining production-floor data. Intercom arrangement, similar to illustrated Executone Inc. system installed in Canadian General Electric Co. plant, permits trained clerical help to do recording.

Some methods of recording variable data which are machine readable are mark-sensed cards, keyboards, and dial settings. Mark sensed cards are in fairly common use, but they tend to result in a high error rate in some cases because marking the cards is a method of indicating numbers which is not familiar to people. Also, the cards must be kept clean and dry if they are to be read properly. With good training, operators, whose principal duty is data recording can be taught to use mark-sensed cards very successfully. Often this is cheaper than some mechanized device for recording data, even though the process being measured is mechanized; especially is this true where readings are not required frequently.

One example of a combination of methods to record preassigned and variable data can be found in the point-of-sale devices proposed (and under test) for department stores. The basic idea of a cash register is to force the operator to record data properly, by combining recording with the function of making change. This is extended in the point-of-sale recorder to include the recording of preassigned data by facilities to read garment tags and customers' credit cards. The variable data is entered as usual on a keyboard. The output, instead of just register readings, is a punched paper tape suitable for direct

entry into a data processing system.

Such a system will work only if: 1. The point-of-sale mechanism forces the operator to perform the necessary functions in the proper sequence. 2. The operators are well trained. The first point means that the device must be programmed so that it tells the operator what to do next at each step.

The use of such devices can introduce additional types of errors into the system, both operator errors and equipment failures, which must be considered in the error control analysis and in programming the computer to detect the errors.

Do not overlook the fact that humans have another method of reporting, that is, talking. In fact, talking is probably the most natural method of communication for man. Due to this, the use of intercommunication devices are becoming increasingly important. They permit the separation of the reporting and recording, so that the recording may be performed by a trained clerk at the other end of the intercommunication system, *Fig.* 4.

One method of reporting data, which has been used where the process is radioactive, is by means of closed-circuit TV. This might be arranged, like the intercom, to permit a clerk to read the data put in front of the remote camera at the operation. TV is probably too expensive for commercial use and there are technical problems in obtaining good readability.

The Shop Recorder Problem

Before leaving the review of equipment it is well to discuss one data input area which is under continual review—the problem of reporting job changes from a manufacturing shop. This problem is of interest because: 1. It must be solved to permit the effective utilization of EDP and tabulating systems in manufacturing control, where mechanized data processing and decision computation promises big payoffs. 2. Significant direct savings are possible especially where separate timekeepers are used. 3. It cannot be solved with a simple approach such as prepunched cards. 4. There are numerous shops large and small with this problem.

In a shop, the recording process must permit the recording of several fields of data every time a man starts or completes a job, or goes on an overhead function (repair, idle time, or getting stock). It is also desirable to be able to report emergency conditions such as machine breakdowns. The usefulness of the device is extended if it can be used for reporting stockroom, receiving, and shipping activity.

One reason that no widely used shop recorder is available is that every industry, and even companies within an industry, have different data recording requirements. The number of characters in a record varies; some need part numbers, others just job numbers. Also the fields themselves vary; for example part numbers might involve from 5 to 15 characters.

Another problem is the need for a printed record at the time of recording. If the data recorded is used as a part of an incentive pay system the worker might be entitled to a document of each job change, or at least a record might be needed which he can sign before it goes on into the data system. On the other hand this problem can be over-rated. Many companies using an intercom type of system do fine with no written records. The number of complaints about pay have actually decreased in most cases when the intercom system is installed because it is more accurate and because the results of one day can be posted the next.

The items noted for shop recording in TABLE I are attempts to solve the shop recorder problem. None of these devices are in wide use at the present time. The technique which has found the widest use in manufacturing shops is the intercom system. Such systems are used in many companies, who report such benefits from them as: More accurate data, and ability to get production and efficiency reports out the next day, and reduced complaints on incentive payment.

Communications Equipment

Since data is of no use unless it is transmitted promptly to a data processing center, communications become important, especially where the data is recorded at some distance (10 miles or over) from the center.

One of the most economical methods of transmitting data, where speed is not vital, is via the mail system. In most cases cards and paper or magnetic tape sent via air express will arrive the next

Fig. 5—Demonstration A.T.&T. Co. equipment illustrates recent advances in communications field. Digital subset, left, can provide on-line telephone link from business machine to business machine. Recorded carrier subset, right, provides for magnetic tape recording of data from slow business machines and transmission via telephone line at maximum rate. At receiving end, another carrier subset records signals and reconverts information for business machine use. Both units provide maximum utilization of telephone time in data transmission.

TABLE 1

Data Recording Equipment and Representative Manufacturers

- Preassigned data preparing devices
  - a. Punched tabulating cards . . . 18*, 23, 31
  - b. Edge-punched cards . . . 15
  - c. Item (garment) tags . . . 11, 19
  - d. Embossed plastic cards . . . 10, 14
  - e. Embossed metal tags . . . 1, 10
  - f. Coding on documents
    - Perforated . . . 9
    - Conductive ink . . . 25
    - Magnetic ink . . . 10, 16
  - g. Ordinary language — magnetic ink . . . 16
- Adding machine to punched paper tape . . . 5, 7, 15, 21, 22, 23, 24, 28, 32
- Bookkeeping machine to punched paper tape . . . 4, 15, 21, 22, 23
- Bookkeeping machine to punched card
  - a. IBM cards . . . 4, 15, 21, 22, 28
  - b. RemRand cards . . . 23
- Typewriter keyboard (alphanumeric) to punched paper tape . . . 15, 20, 31
- Typewriter to punched card
  - a. IBM cards . . . 15, 18
  - b. RemRand cards . . . 23
- Cash register to punched paper tape . . . 5, 22, 23
- Perforated coded tag to punched paper tape . . . 11, 23
- Document Readers
  - a. Conductive spots . . . 25
  - b. Perforated holes . . . 9
  - c. Magnetic ink, ordinary letters and numbers . . . 16
  - d. Ordinary printing (of good quality) . . . 17
- Special-card readers
  - a. Embossed cards . . . 10, 14
  - b. Perforated tags . . . 9
  - c. Mark-sensed cards . . . 18
- Special devices—For example, an alphanumeric keyboard with visual display for checking and with automatic sequencing for format control and insertion of fixed data, as designed for CAA air traffic control system. . . . 2
- Internal communication
  - a. Intercom . . . 3, 12
  - b. Intercom with recorder (T) . . . 13
- Shop data recorders

Method of reading preassigned data	*Method of recording variable data*	*Output*	*Manufacturer*
a. Edge punched cards	None	Punched paper tape	15
b. IBM cards	Instruments and keyboards (T)	Punched paper tape & cards	18
c. IBM cards	Levers (T)	Punched cards	18
d. IBM cards and badges	Dials (T)	Any, to order	8
e. Prepunched cards and badges	Dials (T)	Punched paper tape	27
f. IBM cards	None (T)	Punched cards	18
g. Punched cards	Keyboard	Punched paper tape	†
h. Embossed tags	None	Printed	10

- Data communications systems

Input	*Link*	*Output*	*Speed*	*Checking*	*Manufacturer*
a. Documents	Telephone or radio	Facsimile copy	About 3 min/doc.	None	26, 30, 33
b. IBM card	Telephone	IBM card	To 14 card/min	Readback	18
c. Various (tape, card, etc.)	"	Same as input	To 100 char/sec	None	3
d. 5 level paper tape	Teletype	"	10-60 char/sec	None	3
e. Card or paper tape	Telephone	"	To 300 char/sec	Parity & other	6
f. Paper tape	Telegraph	"	To 10 char/sec	Parity	15

*Numbers refer to list of manufacturers following. (T)—Punches time automatically.
†Special devices designed by Consolidated Avionics Corp., Westbury, L. I., N. Y. for their own use.

day between almost any major points in the country. The cost per character for such transmission is very reasonable (as many as 10,000 characters/cent can be transmitted). Where better than overnight service is required, wire transmission must be used, *Fig.* 5. Basic teletype presents problems in that it represents alpha-numeric data in a 5-level code which not only does not allow checking, but also does not permit an unambiguous representation of the 45 or so characters and numbers ordinarily used. Other data communication devices solve the accuracy problem by using 7 and 8-level codes which permit the use of parity and other character-by-character checks. Some new systems also use read-back techniques and similar checks on the messages. These new systems transmit data at the approximate rate of 100-1000 characters/cent.

▶ Future Equipment Developments

It is not likely that a general purpose input recorder will be developed in the near future. The requirements of different industries seem to be too varied. Also, it sems unlikely that a device can be designed in the next few years which could be programmed for various applications the way a computer is programmed. A data recorder must be inexpensive and internal programming implies high costs.

Therefore an off-the-shelf item which satisfies all needs will not be available in the near future. However, standard units for retail stores and for shop recording should be available soon which fulfill many companies' needs. If a company wants special data recording functions performed, a good approach might be to have a special manufactured perhaps as a modification of some existing item. The cost of such a development must be carefully studied, of course.

If special equipment is not used, it may be necessary to modify system requirements and/or use the less sophisticated but more flexible semiautomatic devices such as simple keyboards or intercoms. In the long run, as the operations themselves become more automated (as for example, automatic vending devices in the case of retail operations), the data recording function will become more easily handled, being incorporated as part of the automatic equipment itself.

▶ The Design Procedure

Having surveyed the equipment and techniques available for recording data, and having discussed error control, it is time to set forth a recommended over-all design procedure. A general approach which seems to work well for the design of input systems is the following:

1. Study the data input requirements, noting the factors which have been listed. Add to this any new requirements (and eliminate unnecessary ones) as a result of the study and design of the entire data processing system, if a study is made.

2. Select from the suitable equipment available two or three systems involving recording, communicating, and translating equipment and human clerks which will properly record data and produce the media needed by the central processing system. For these systems and for the present system (as a basis of comparison) draw data flow charts for each major type of transaction. On these graphs show: The volume of data; a first estimate of the average cost per record; the input error rate; and note the flow of special cases, where they occur in a significant volume.

3. Go over these preliminary designs to determine how best to introduce economical error detection and correction methods.

4. After several reviews the point will be reached where it will be possible to plot an error-cost curve. A graph should be prepared for each major data flow. In the department store example this might be for: Cash sales, credit sales, and receipts. Note that, at this point, it is safe to assume that the processing system introduces no significant number of errors, as indeed it does not, if properly designed. Show on

Manufacturers

1. **Addressograph-Multigraph Corp.**, Cleveland, Ohio
2. **Aeronutronic Systems Inc.**, Newport Beach, Calif.
3. **American Telephone & Telegraph Co.**, New York, N. Y.
4. **Burroughs Corp.**, Detroit, Mich.
5. **Clary Corp.**, San Gabriel, Calif.
6. **Collins Radio Co.**, Burbank, Calif.
7. **Comptometer Corp.**, Chicago, Ill.
8. **Control Data Corp.**, Minneapolis, Minn.
9. **Cummins-Chicago Corp.**, Chicago, Ill.
10. **Dashew Business Machines Inc.**, Culver City, Calif.
11. **Dennison Mfg. Co.**, Framingham, Mass.
12. **Dictaphone Corp.**, New York, N. Y.
13. **Executone Inc.**, New York, N. Y.
14. **Farrington Mfg. Co.**, Needham Heights, Mass.
15. **Friden Calculating Machine Co. Inc.**, San Leandro, Calif.
16. **General Electric Co., Computer Dept.**, Phoenix, Ariz.
17. **Intelligent Machine Research Corp.**, Alexandria, Va.
18. **IBM Corp.**, New York, N. Y.
19. **A. Kimball Co.**, New York, N. Y.
20. **Kleinschmidt Laboratories Inc.**, Deerfield, Ill.
21. **Monroe Calculating Machine Co.**, Orange, N. J.
22. **National Cash Register Co.**, Dayton, Ohio
23. **Remington Rand Div. Sperry-Rand Corp.**, New York, N. Y.
24. **Sorobon Engineering Inc.**, Melbourne, Fla.
25. **Standard Register Co.**, Dayton, Ohio
26. **Stewart Warner Corp.**, Chicago, Ill.
27. **Stromberg Time Corp.**, Thomaston, Conn.
28. **Systematics Inc.**, Hermosa Beach, Calif.
29. **Teletype Corp.**, Chicago, Ill.
30. **Times Facsimile Corp.**, New York, N. Y.
31. **Underwood Corp.**, New York, N. Y.
32. **Victor Adding Machine Co.**, Chicago, Ill.
33. **Western Union Telegraph Co.**, New York, N. Y.

these curves the present cost-error rate point as a means of comparison. Where one source document affects several outputs the data with the curve should show how input errors are divided among errors in the outputs. For example, a credit sale affects both customer statements and sales reports on the average, but all errors in this input affect customer statements.

5. At this point, the proposed systems should be reviewed briefly with management. First, the systems should be discussed with operating management and auditors to be sure that no significant factors have been overlooked. Then the system should be reviewed briefly with top management, leading to a discussion of the cost-error rate curves. At this point, management should make a preliminary selection of the operating point for each type of transaction; in other words determine the amount they are willing to pay for error control and the corresponding error rate.

6. With the error rate specified the appropriate system can be chosen from among the several preliminary designs. Further review at this point is in order to see if this system can be improved through better arrangement of equipment and procedures, or perhaps with the use of newly announced equipment.

7. Now the details of the systems and procedures must be filled in. This is a job which requires close attention to every point along the flow of data and to every foreseeable type of error and exception.

How will the system handle all types of input, even the low volume exceptions? Some exceptions will be handled through the main recording devices and others by separate procedures. For example, it has been proposed that an intercom system be used in conjunction with a mechanized shop recorder. The recorder would record all normal job changes, and the intercom (and appropriate clerical operators) would be used to record machine breakdown, material shortages, and other exceptions.

The method of error detection and correction at each control point must be specified in detail. This may involve establishing specifications for the design of special devices which check a redundant digit; it may involve the definition of procedures for clerks for taking batch totals; and it may require some preliminary programming of the error checking computations to be performed by a computer.

The exact specification of all electronic, mechanical, and communications channels is required to insure that the vendors supply the proper, compatible items. Where equipment from various sources is to be used, consultation with an experienced, independent EDP engineer is highly recommended.

8. With the detailed system completely specified, and again checked with operating management, a detailed cost study may be made. This will lead to conclusions as to the economic feasibility of the system. Often a system which looked good up to this point turns out to be economically unjustified. This is a disappointment to the systems designer, but should be recognized as a fact of business life. The designer must then, of course, either repeat the process in the hope of finding a better system, or turn his attention to other more promising systems problems. There is no magic formula that says that the data input area will always be capable of improvement through mechanization.

9. If the system proves feasible, it is most vital to lay out a detailed implementation plan, showing the exact steps and the proper sequence for changing over from the old to the new system. A major decision here will be choosing the sequence of conversion: Area by area, function by function, or some combination of these. From the data input system standpoint alone, the area by area approach is usually preferable. The first area then serves as a test of the system. For an over-all data processing system program, the function by function approach is sometimes easier. Compromises have to be worked out. For example, in the first area implemented all data might be recorded such as to test the input system, with some of the recorded data being reconverted to a manual form for further processing; other data might be fed into the entire mechanized processing system to test it on one function, for example, cash reconciliation from cash sales data.

A very vital step in the planning for implementation is to designate who will be responsible for the conversion in each phase. Generally, the system designer is responsible at first. He works through the line organization, of course. When the system is operating reasonably well, the appropriate line supervisor takes over full supervision. For each step of conversion a number of questions must be answered: What equipment is required and when? What personnel and training are needed? What is the exact timetable for the various detailed steps of the conversion? Have the exact changeover procedures—including the important decision as to whether or not to run the new and old systems in parallel, and if so for how long—been defined? What will be the criterion for cutting over completely? What arrangements must be made to close off the old system and reassign personnel?

10. Finally, when the implementation plans are complete and approved, the program is initiated.

Economic Feasibility

Before leaving the design procedure completely, it is important to review the approach to economic feasibility, for this is what sells management on investing in a new data input system. The economics of an input system are studied by the same methods used to study any other proposed capital investment. First the initial outlays (before the system is operat-

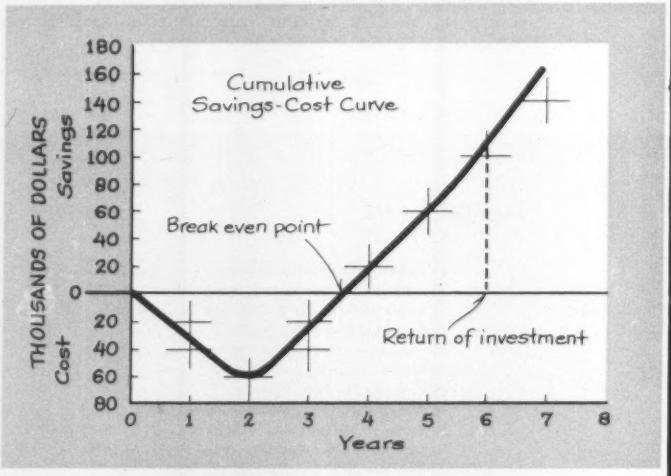


Fig. 6—Long range look at cumulative savings-cost picture will show management breakeven point and point at which return of investment should occur. Decision as to whether or not to adopt a system should be based on many factors, not simply the rate of return of investment.

Evaluating The Suitability Of Data Recording Equipment

☑ Are the costs of preparing the input media, such as special tags or magnetic printing, reasonable? Embossed tags, for example, are an effective input medium but can be expensive to prepare, as they involve special materials for the card or tag, and a punched-card-to-tag converter.

☑ Is the data recorder unit foolproof? For example, is it self programming, so that the operator has to enter data in the proper sequence? Are there appropriate devices to prevent cards or tags from being inserted incorrectly?

☑ Are the system and the media designed to withstand the existing environment: Dust, noise, etc.? Tabulating cards, for example, are difficult to use in some shops because of dirt.

☑ Is there enough character capacity on the media for the preassigned fields? If a proposed employee badge can handle only five digits and the proposed system requires six then either the equipment must be changed, or (and this is very difficult) the company must change its numbering system. Be sure to note where alphabetic data must be handled, as many data handling units are numeric only.

☑ Can enough characters be handled in the variable inputs? Is this enough for a system where both employee number and quantity are to be entered as variable fields?

☑ Are physical installation costs included? Where a number of recording units tie into a central tape punching station, are the wiring costs reasonable?

☑ Does the unit automatically insert standard data as required, such as time, department number?

☑ Does the unit create checking digits or batch totals for variable fields?

☑ Does it automatically check redundant digits attached to preassigned fields? If so, are the operating procedures of the error cases ones that promote prompt, accurate correction of data? Are the proper error signals recorded for error correction later in the processing?

☑ Does the system force the preassigning of information, such as quantities, which should really be variable? This not only creates obsolete data, but also creates more data. In a shop, for example, data would be needed for every operation, rather than for each job.

☑ Is the equipment sufficient to handle peak loads? Does it allow for growth?

☑ Does the system produce an output in a code and on a medium which the data processing system can handle, preferably with no further conversions?

ing fully) are determined. These form the "investment." Then the operating costs under the new system are compared with the costs under the existing system (allowing for future growth). Presumably the new system is less expensive to operate, or brings other benefits utilimately measurable in increased profits. The net benefits of the new system are the savings—the return on the investment. If top management judges this return on the investment to be adequate and the improvement in customer service and management control to be worthwhile, then the program will be approved.

The important point is to be sure that all factors have been included in the cost study and have been reasonably well estimated. A cumulative graph that summarizes the savings-cost data will help management visualize the economic picture, *Fig.* 6. In looking at the economics of a particular case, it may be that the savings per year do not indicate a remarkably high rate of return. However, the program might be well acceptable to management in view of the facts that there is little risk of obsolescence in the investment since all companies will record data for many years to come, and the system will improve the accuracy in management reports and customer statements. Equally important, the more complete and accurate data from a well designed system would permit management to seriously consider installing a better inventory control and sales prediction system which a separate operations research group should be developing and which depends upon having accurate, timely data.

▶ Conclusions

There are three reasons for undertaking a study of data input areas: 1. There is the possibility of a direct reduction in data handling costs. This is often possible where there are separate data recording personnel, where operating personnel use a large part of their time for data recording, or where many manhours are spent in transcribing and/or checking and correcting inputs. 2. Where a centralized mechanized electronic data processing system is proposed its success may depend upon having "clean", error-free input data. Thus it is necessary to replace the manual recording, editing, and correcting systems with a mechanized input process. This may not result in direct savings in the input area, but permits over-all savings. 3. Often significant competitive advantages can be obtained through the use of more sophisticated forecasting and decision-making procedures. Where these depend upon accurate, timely data, as is usually the case, an improved input system may be required.

To realize any of these improvements through the improved input system, a very complete study of data input requirements is needed. Often the study of the input system is as extensive as that for the central data processing system. This must be followed by intelligent systems design, and an honest evaluation of costs. Only where the desired pay-off and/or benefits are indicated should a new system be installed.

OVERHEAD CONVEYING SYSTEM

PERMITS SELECTIVE ROUTING

ONE PHASE of the extensive materials handling problem at the Range Div., General Electric Co. is concerned with movement of metal parts from fabrication lines through a pickling process to the beginning of vitreous enameling operations, *Fig.* 1. The parts to be treated prior to enameling vary in size and shape from small vent tubes to fabricated shells of 40-inch range bodies. Power and free conveyors, manufactured by Jervis B. Webb Co. and similar to the type in use in automotive plants, were chosen to solve this handling problem.

Design of a power and free conveyor provides for a separate motivating power source in the form of a moving endless chain equipped with pushers that transmit power to individual free trolleys supporting the load to be conveyed. As shown in *Fig.* 2, an installation consists of an I-beam track joined to a double channel track by steel plate yokes spaced at intervals. The I-beam section provides a track for power trolleys that support, and are joined by, the endless chain. The double channel section provides a track for the four-wheeled free trolley from which the type of carrier appropriate to the need can be suspended.

The relative spacing between the power and the free tracks determines whether or not the pusher attachment on the power source can engage a free trolley. Pusher dogs on the free trolley are pivoted to permit the pusher attachment on the power source to deflect a dog as the moving pusher overtakes a free trolley; the pusher then engages the second dog and the free trolley moves at conveyor speed. At desired points in the system, disengagement is automatically accomplished by providing an increased spacing (2 inches) between the power and the free tracks.

For systems which require that the power chain continue to move even though a free trolley is prohibited from moving, special spring loaded pushers are used in lieu of solid pushers, *Fig.* 3. Characteristics of the spring insure that the pusher and pusher dog stay engaged for a free trolley capable of movement but that the force buildup on a trolley

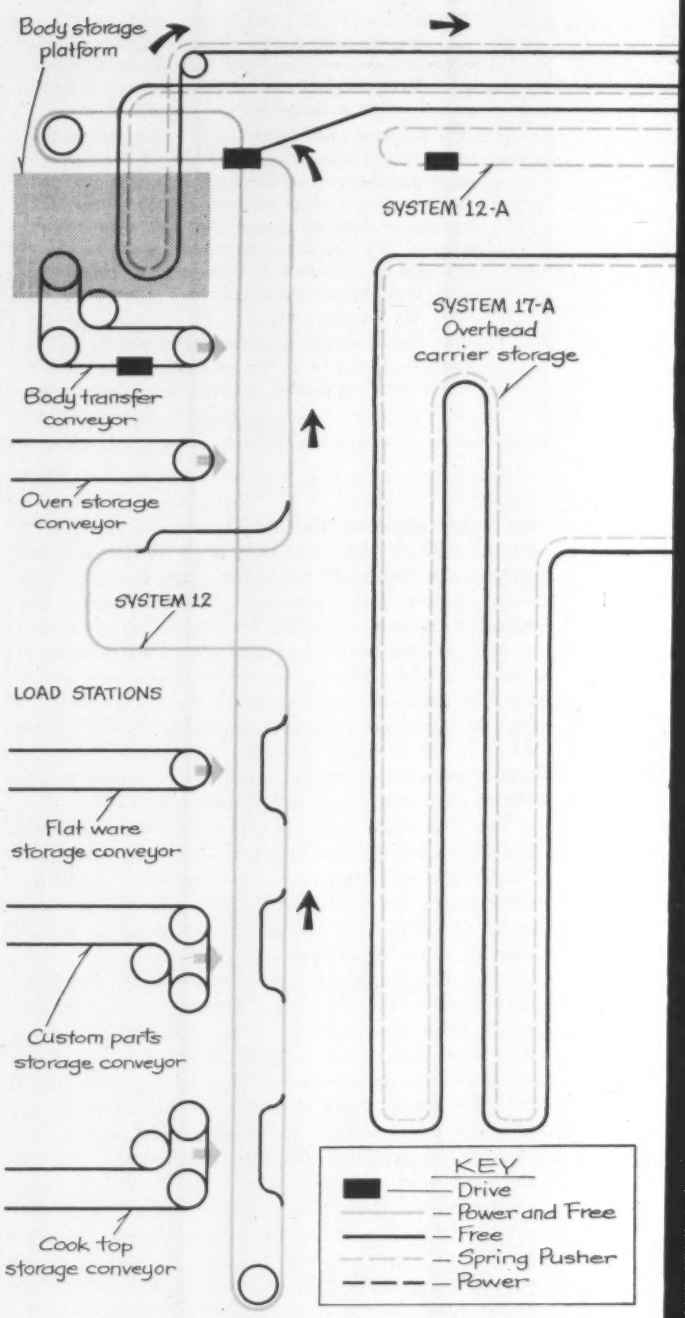


Fig. 1—Schematic diagram of power and free conveyor system installed by Range Div., General Electric Co. Purpose of system is to move newly fabricated metal parts from five load stations through pickling machines to four unload stations ahead of enameling lines.

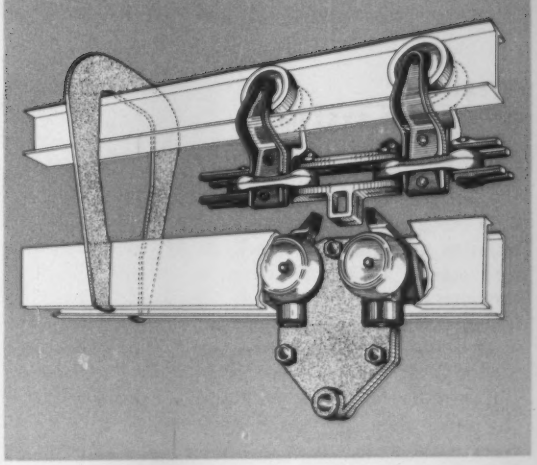
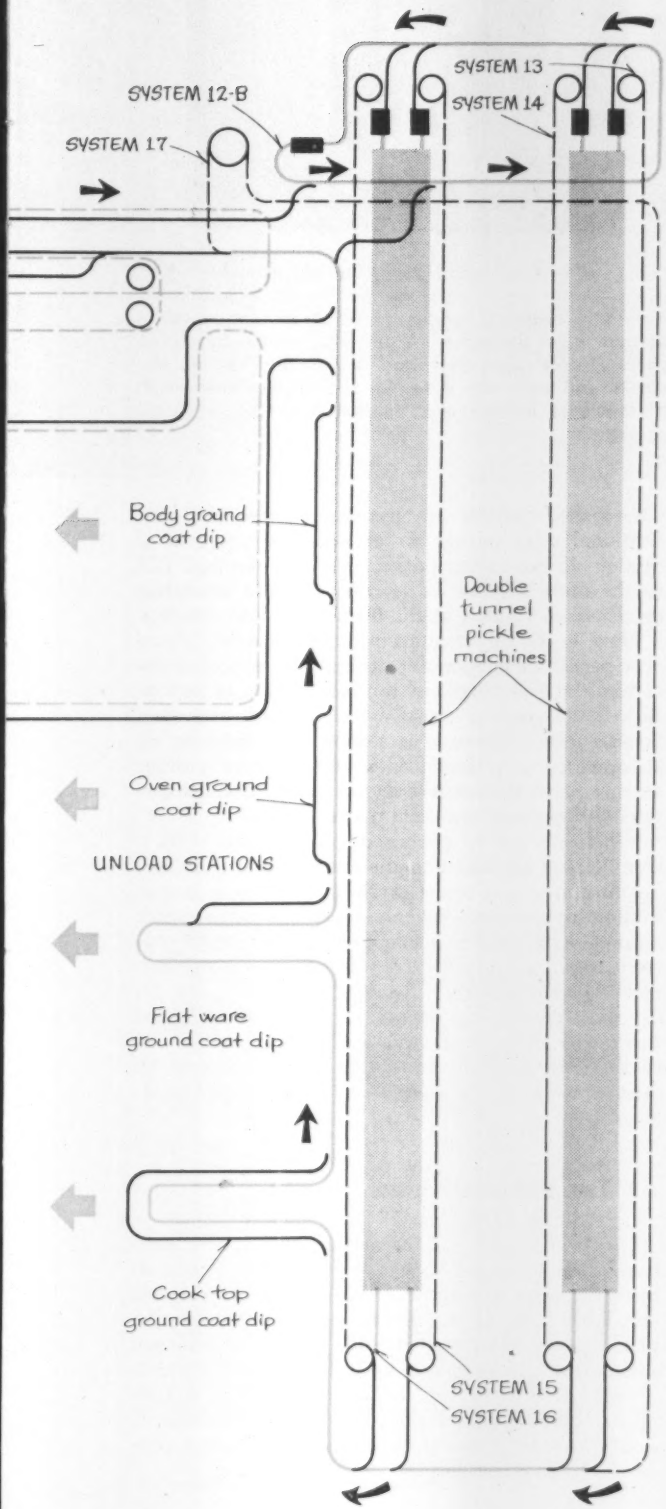


Fig. 2—Conventional power and free conveyor system includes two tracks. The I-beam section supports power chain; double channel section supports free trolley and load to be conveyed.



which is held stationary will simply cause the pusher to deflect out of engagement. This provision, for example, permits the continual buildup of loaded carriers at the outlet of a system where the carriers may be subsequently processed on demand.

Power and free conveyors can be equipped with track switches which permit free trolleys to be transferred between different systems, including transfer to free lines where gravity or manual power moves the individual trolleys. Automatic operation of the switches is possible. Where automatic selective switching is desired, a free trolley carrier can be provided with means to operate only certain switches as well as to identify whether or not it is a loaded or empty carrier.

Wherever a free trolley is to be introduced into a system already containing other moving trolleys, such as at switching points, control means are provided to insure that transfer occurs only when there will not be interference with the moving free trolleys. The controls determine that a pusher is approaching the transfer point and senses whether or not it is engaged with a free trolley. If the system can accept a trolley, switching occurs and the free trolley is introduced into the system just ahead of the empty pusher.

▸ An Operating System

To take advantage of these features in a handling system, the Range Dept., has installed approximately 6100 feet of power and free conveyors. As shown in *Fig.* 1, the installation is in nine sections, numbered for plant purposes as 12, 12A, 12B, 13, 14, 15, 16, 17, and 17A. With the exception of sections 12A and 17A which are spring pusher types, the conveyors are equipped with conventional solid pushers.

The beginning conveyor in the system, Section 12, services five load stations that handle: 1. Doors, panels, inner doors, and drip trays; 2. Custom built-in fronts and cooktops; 3. Regular cooktops; 4. Oven liners; and 5. Free standing bodies. All parts are destined for the pickling and vitreous enameling operations.

Each free trolley used in the system is equipped with electrical wiper tabs wired in a particular combination to cause the track switch at a particular load station to actuate when an empty trolley approaches the station, *Fig.* 4. As an electrical wiper makes contact at its designated load station, a solenoid valve is activated, opening the track switch by means of an air cylinder. The carrier, moving into the station, rolls by gravity to the loading point. At the same time, it trips a limit switch to close the track behind it. The following carriers thus bypass the station, or, if otherwise set, the track switch allows the next carrier to enter, if it is designated for that station. Each load station supplies space for more than one carrier and bumper assemblies on the free trolleys prevent work on abutting carriers from being damaged.

After a carrier is loaded with ware the operator sets a star wheel on the carrier bumper to indicate that it is loaded. The operator then manually releases a hand stop. The loaded carrier moves by gravity to an air-operated stop and feeder point ahead of a loading switch where it awaits a space on the main line.

When an empty pusher dog approaches, the waiting loaded carrier automatically passes through the track switch into the main line. It is then ahead of the empty pusher dog which gave the track switch the actuating signal. Once more, the carrier is under power on the conveyor of Section 12.

As the loaded carriers approach the unloading track switch at the intersection of conveyor Sections 12 and 12A, the star wheel settings differentiate between a loaded carrier and an empty. The combination of star wheel setting and trolley wiper tab, creating a circuit, trips the unloading track switch.

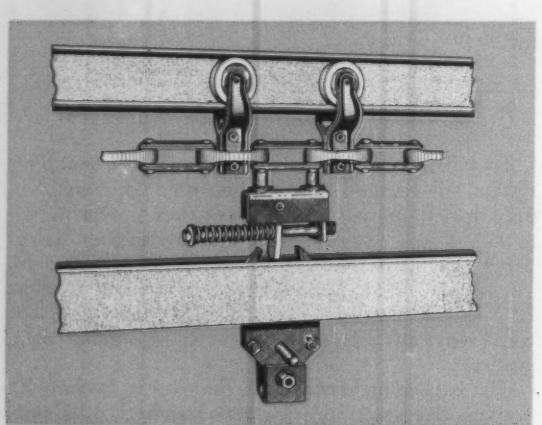


Fig. 3—In lieu of solid pusher attachment shown in *Fig.* 2, power chain may be equipped with spring pusher attachment shown here. If free trolley is restrained, spring pusher attachment will deflect out of engagement with pusher dogs on free trolley.

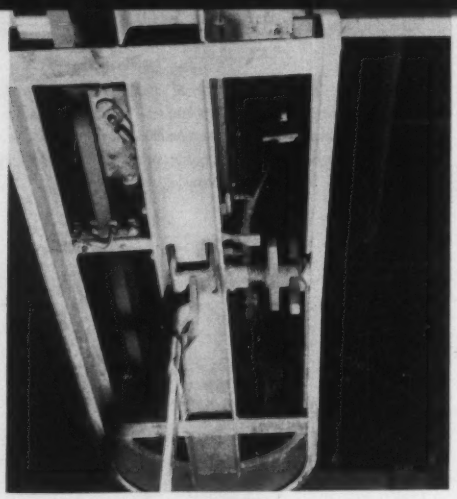


Fig. 4—View from below shows bumper assembly which is located on each carrier at point carrier is suspended from free trolley. Bumper protects work on abutting carriers from damage. Wiper tabs which, by wiring pattern, determine what load and unload stations the carrier will enter are shown at left. Star wheel which distinguishes loaded and unloaded carriers is shown at right.

The loaded carriers are transferred from the conventional solid pusher power and free conveyor of Section 12 to spring pusher conveyor Section 12A in the same manner as described for the unloading track switch located at the fabrication load stations.

Now, assuming there are no loaded carriers ahead of a particular carrier, the spring pusher pushes the carrier the full length of the loaded side of Section 12A to a point of transfer to the third conveyor, Section 12B. There it is stopped and held by an air-operated stop and feeder. The spring pushers at this point flop over dogs on the stationary carriers and proceed on their normal route.

When an empty pusher dog on Section 12B is identified as approaching the transfer point, an air-operated stop and feeder on Section 12A is activated, feeding the carrier through a loading track switch onto the conveyor of Section 12B. The carrier proceeds under power of a fixed pusher dog to the four pickling machine lines: Sections 13, 14, 15, and 16. Controls can be so set that the approaching loaded carrier will hunt—and find—an empty space on one of the four sections, or the controls can send all carriers to predetermined lanes under manual guidance.

The Pickling Process

Up to this point in the system, all carriers have been spaced on the several conveyors on 9-foot 4-inch centers, and have been moving at variable speeds of from 12 to 60 feet per minute. At the pickling machine, spacing of carriers is changed automatically to 4-foot 8-inch centers and speed is adjusted from 4 to 28 feet per minute. This utilizes all available space in the pickling machine, *Fig.* 5, and allows the proper speed for best pickling conditions to be established.

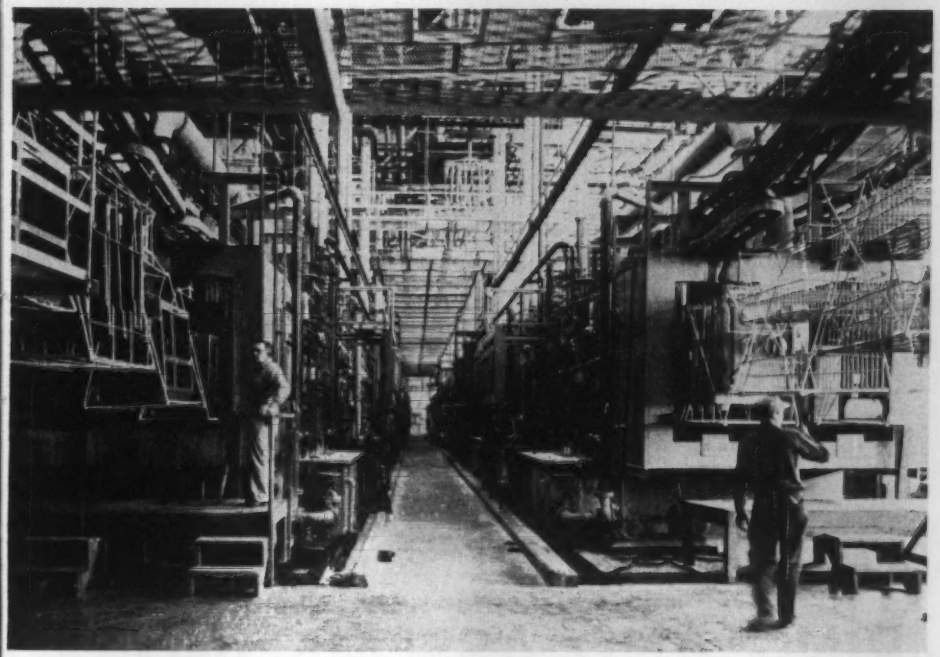


Fig. 5—Carriers entering pickling machines are placed closer together to obtain maximum production and material usage. Only the metal parts and carriers are exposed to the pickling process.

With the journey through the pickling process completed, the loaded carrier is held at the main line exit by another stop and feeder, awaiting an empty pusher dog on Section 17. When a space is available the carrier moves through a loading switch, as has been described, and is returned to 9-foot 4-inch centers. The work then moves, on 9-foot 4-inch centers, to one of four ground-coat dip stations —free conveyor areas adjacent to the conveyor of Section 17 which operate identically to the fabrication loading stations. Here the work is unloaded from the carrier, dipped, and loaded onto other conveyors where enameling is completed, *Fig.* 6. After unloading at the dip station the operator releases the carrier. It is picked up again by power dogs of Section 17 and carried to an overhead transfer point for transfer to one of the two return legs of Section 12A.

Should the dip stations be filled, and thus bypassed by a loaded carrier, the carrier continues to circulate through the system. It returns to conveyor 12B, and proceeds through the pickling machine again. Paced production reduces this occurrence to a minimum.

Conveyor Section 12A contains spring pusher type attachments and empty carriers are banked ahead of the fabrication stations located along conveyor Section 12. Empty carriers are released alternately from the two return legs of Section 12A to Section 12, thus providing empty carriers for delivery to fabrication stations.

The benefits from the system include: Simplification of inventory control; variable selection of parts; reduced losses due to transfer mishaps; cleaner ware along the line; operation supervision at a minimum; no slow-downs with paced production; parts stacking ahead of pickling; smoothness of periodic model changes; and maximum production through pickling machines.

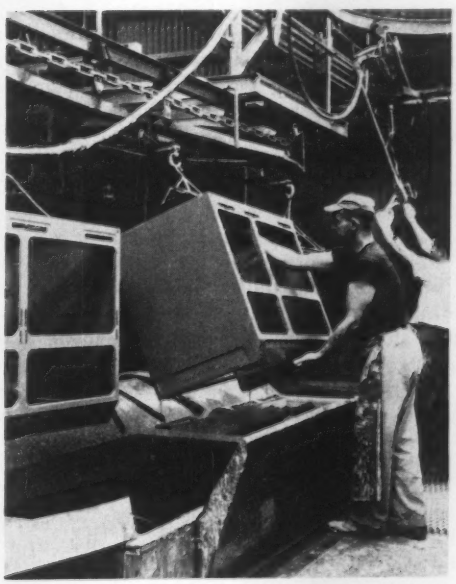
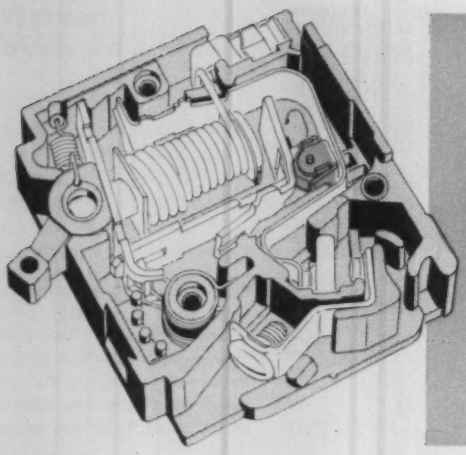


Fig. 6—At completion of pickling process carriers are directed to unload stations where ware is removed from carriers and dipped. In this view, range bodies have been removed from power and free system (rear) and dipped, and are shown being attached to an overhead chain conveyor for transfer through enameling operation.



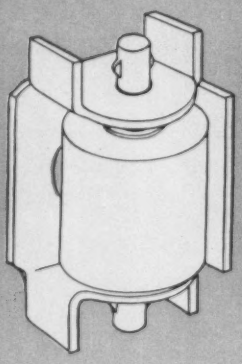
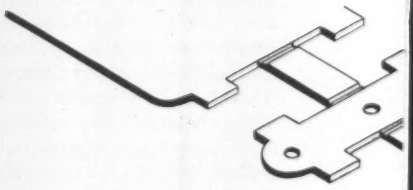


Fig. 1—Major elements of electrical circuit breaker are illustrated in cut-away sketch showing breaker with cover removed. Enlarged view of roller assembly illustrates combination of stamped and machined parts used. To place breaker in its closed-circuit condition, roller assembly is pushed by a toggle bar so that it presses against a formed, flat spring element. Spring element contains movable contact that closes against fixed contact. Toggle bar is disengaged from roller on overcurrent, opening movable contact.

CIRCUIT BREAKER MANUFACTURE

STAMPING AND ASSEMBLING ROLLER UNITS



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PROGRESSIVE DIES that incorporate a number of operations in one tool have long been recognized as a useful means of increasing production and lowering costs of stamped metal parts. Through their use, production of a variety of intricate parts involving such operations as blanking, piercing, and forming can be accomplished at high speeds in a punch press. Usually, coil stock is advanced automatically through the multiple stages of the die by an accessory hitch or roll feeding device powered by the press.

A logical step in further automating a progressive die operation is incorporated in tooling for manufacture of roller assemblies, *Fig.* 1, used in electrical circuit breakers made by Murray Mfg. Corp. The setup, *Fig.* 2, provided by Halm Instrument Co. Inc. as a part of a complete automation program for the manufacture of circuit breakers (See AUTOMATION, Oct. 1958), includes provision for introducing supplementary piece parts that are assembled to the basic part while it is being produced in the die.

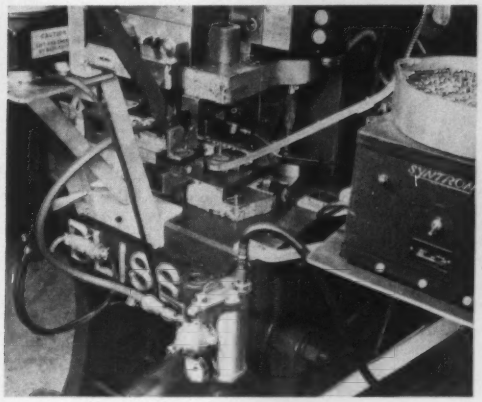
Although simple punch press assembly operations are fairly common, as in the attachment of preformed solderless connectors to the ends of electrical wires, they are usually manually controlled and require the constant attention of an operator. In the case of connector assembly, fabrication of the connector in the same press used for assembly is rarely attempted. Also, output rates are limited due to the necessity of visually checking the placement of the individual parts in the press and inspecting each completed assembly.

A description of the roller assembly application is therefore of interest because of the complexity of the assembly produced and the relatively high output —60 assemblies per minute—obtained. Elimination of the need for a full-time attendant is also an important advantage of this installation.

Starting with a 32-ton back-geared Bliss punch press, Halm engineers installed a progressive die designed and built by August W. Holmberg & Co. Inc. and added accessory parts feeders and tracks. Details of operation of the automated system are outlined in *Fig.* 3.

Strip stock, fed by an automatic hitch feeding device, is advanced progressively through the various stages of the die. When forming of the basic part from the stock reaches a satisfactory state, a brass roller is inserted between the two legs of the basic part and held in place by a ram. The ram operates vertically from underneath the die, and picks up the roller from the end of a feed track leading from a vibratory unit.

At the same die stage at which the roller is in-



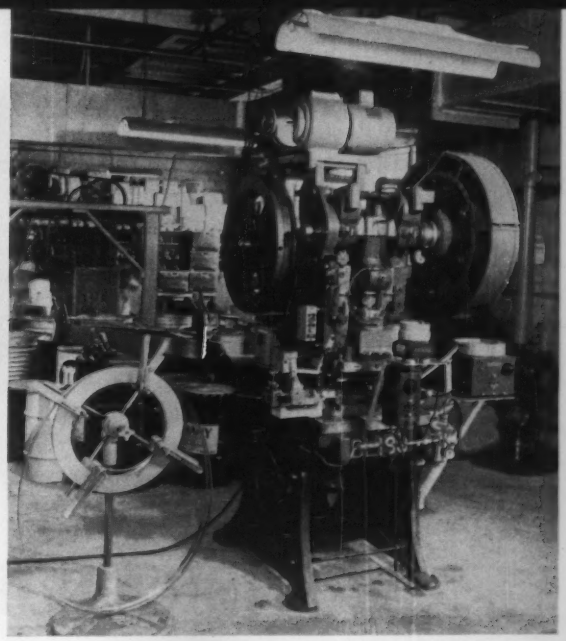


Fig. 2—Punch press setup combines fabrication of basic part in a progressive die and assembly of supplementary piece parts introduced by parts feeders. Close-up view of die area shows feed tracks that contain pins and rollers. Output is 60 assemblies per minute.

serted, a pin is released from the track of a vibratory feeder and moved into position by a slide. A second ram is actuated that inserts the pin through holes in the basic part and the roller.

The projecting ends of the pin are crimped to secure the assembly at the next die stage. In a final stage, the completed assembly is sheared off and ejected. The tab produced at the leading end of the next-to-last part is bent down by the shearing punch.

The hitch feeding device, slide, and inserting rams are powered by the press. Operation of these elements is synchronized with the press stroke.

Combining of stamping and assembly operations in a punch press makes efficient use of the machine, and takes advantage of the fact that the basic part is securely held and oriented at the point of assembly. The principles employed in this application might well be considered wherever parts that are fabricated in a punch press are subsequently incorporated into assemblies.

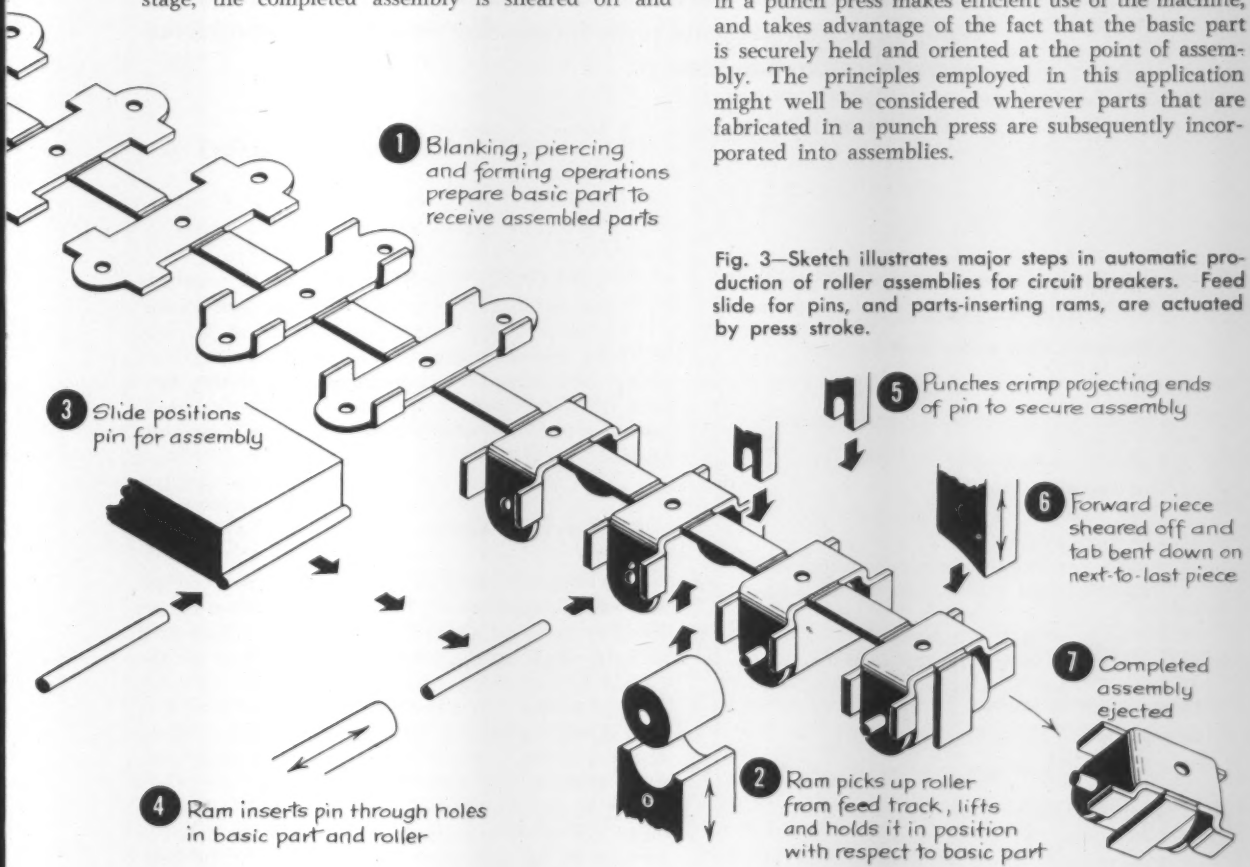

1 Blanking, piercing and forming operations prepare basic part to receive assembled parts
2 Ram picks up roller from feed track, lifts and holds it in position with respect to basic part
3 Slide positions pin for assembly
4 Ram inserts pin through holes in basic part and roller
5 Punches crimp projecting ends of pin to secure assembly
6 Forward piece sheared off and tab bent down on next-to-last piece
7 Completed assembly ejected

Fig. 3—Sketch illustrates major steps in automatic production of roller assemblies for circuit breakers. Feed slide for pins, and parts-inserting rams, are actuated by press stroke.

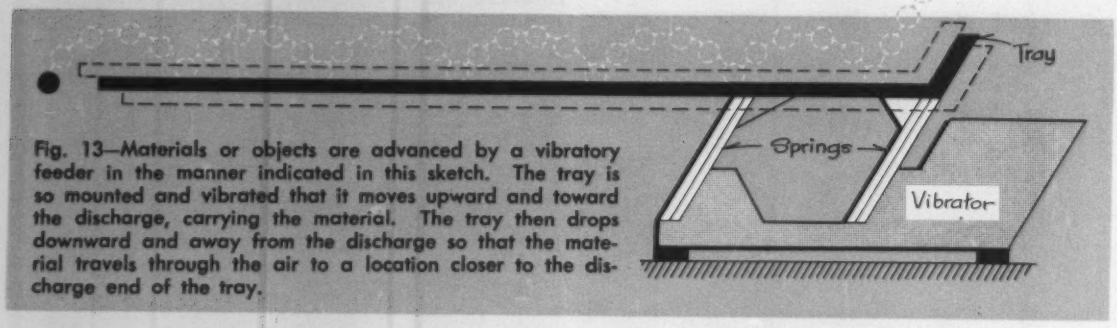


Fig. 13—Materials or objects are advanced by a vibratory feeder in the manner indicated in this sketch. The tray is so mounted and vibrated that it moves upward and toward the discharge, carrying the material. The tray then drops downward and away from the discharge so that the material travels through the air to a location closer to the discharge end of the tray.

USING VIBRATION INDUSTRIALLY — 2

VIBRATORY FEEDING AND CONVEYING

Uses of vibratory devices in conveying and feeding have rapidly increased, and many possibilities have been uncovered that have yet to be exploited fully. The author discusses applications of this equipment and presents some interesting examples ranging from oyster shells to hot castings.

By **LESTER R. MOSKOWITZ,** Director, L. R. Moskowitz & Associates, Erie, Pa.

TABLE 5—Features of Vibratory Conveyors and Feeders

Advantages

1. Perform special operations in addition to moving material.
2. Simplicity of construction.
3. Low maintenance.
4. Close control of output and feed rate.
5. Few moving parts.
6. Readily handle hot or corrosive materials.
7. Operating parts remote from the discharge point.
8. Discharge abruptly into space.
9. Conveyed objects fully supported.
10. Permit 90-degree changes in direction with small change in levels.

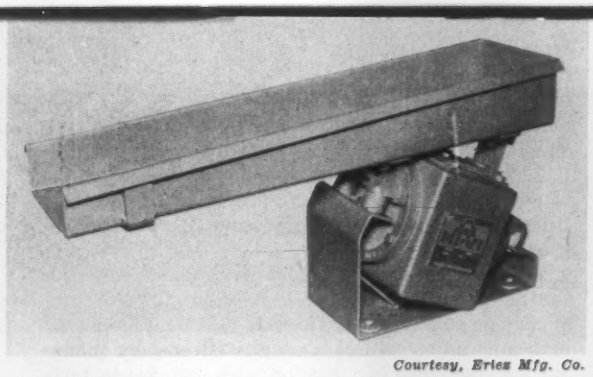
Disadvantages

1. Specialized know-how required for selection and service.
2. Maximum upward slope limited.
3. Side effects may be detrimental.
4. May damage objects or material.
5. Limited adaptability when designed for special operations.

VIBRATORY EQUIPMENT used for conveying or feeding employs vibration generating devices of the basic types discussed in the first article in this series (See Part 1—AUTOMATION, Dec., 1958). The vibrators are mounted so that they impart vibratory forces to suitable rigid troughs, trays, bowls, or tracks on which items or material are transported.

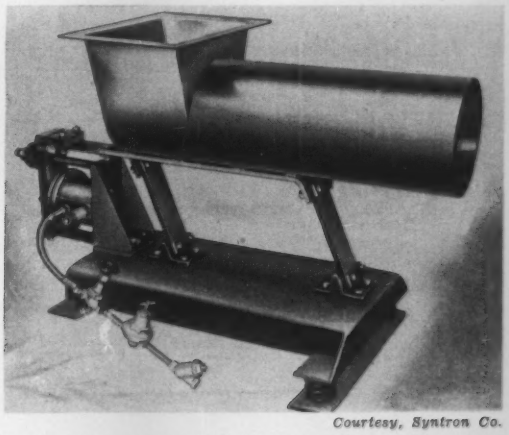
How They Work

The effect of vibration properly applied to a rigid tray is indicated by *Fig.* 13. The vibration causes the tray to move alternately forward and backward at some angle to the horizontal. An object on the tray is carried along with the tray on the upward-forward stroke. As a result of gravity and inertia, it falls through a ballistic trajectory to a position ahead of the starting position during the downward-backward stroke of the tray. In this manner the object moves along in a series of hops. The action of other vibratory conveying or feeding devices is the same as in this tray example. However, in the heli-



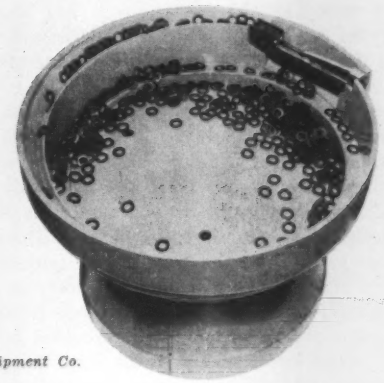
Courtesy, Eriez Mfg. Co.

This linear feeder with standard tray is driven by an electromagnetic vibrator of the ac-permanent magnet type.



Courtesy, Syntron Co.

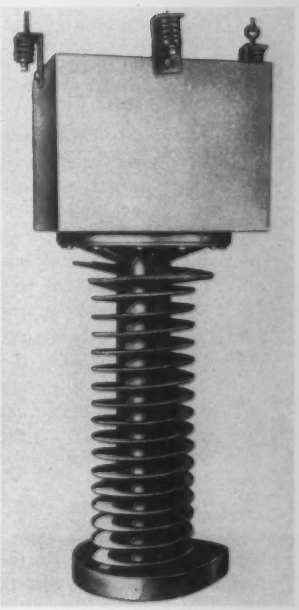
Standard linear feeder with tubular trough is here driven by a liquid-operated piston-type vibrator.



Courtesy, Perry Equipment Co.

Widely used type of helical feeder is represented by this pulsating dc electromagnetic type unit.

In this unit the electromagnetic pulsating dc type vibrator is designed to be suspended and drive a long helical ramp.



Courtesy, Syntron Co.

Fig. 14—These examples illustrate the two basic types of vibratory handling devices—linear and helical. Both types operate on the same fundamental principle to move material.

cal units such as bowl feeders, the track or tray is wrapped around an axis, and the vibratory motion must act around that axis.

▶ Typical Units And Applications

Vibratory devices used for conveying are designed primarily to move materials from one place to another over distances of 6 feet or more. Feeders are designed to move materials over relatively short distances and perform other functions such as pacing of flow or orienting of parts. Some typical feeder configurations are illustrated in *Fig.* 14. Standard tray shapes for vibratory feeders are indicated in *Fig.* 15. Except for their size, conveying units are very similar to the linear feeders.

Many possibilities exist in developing vibratory equipment for a particular feeding application. Standard subassemblies can be combined in a number of ways with or without custom elements. The specific units in *Fig.* 16 illustrate some of these possibilities—using separate units in tandem, using separate units in parallel, using vibratory elements in parallel on a single tray, using a special tray such as a water jacketed tube, using a vibratory hopper with a parts elevator, and using a linear feeder to supply parts from a hopper to a helical feeder.

Some specific applications of helical feeders are indicated in *Fig.* 17. The range of small products that can be handled is great—it includes metal parts ranging from simple symmetrical shapes to odd or difficult parts such as springs. It also includes glass forms, and plastics.

Specific applications of linear feeders and conveyors are shown in *Fig.* 18. In the case of these units, the range of products handled is also very great. The examples shown include oyster shells, hot castings, food products, and other items.

▶ Characteristics

In general, vibratory equipment represents one of the most versatile handling means that can be used in automatic operations. Vibratory feeders and conveyors are not directly comparable to any other type of device since no other single device provides the same movement of material and useful auxiliary effects. When compared to bucket conveyors, belt conveyors, and screw conveyors solely on the basis of quality of material moved and cost, vibratory

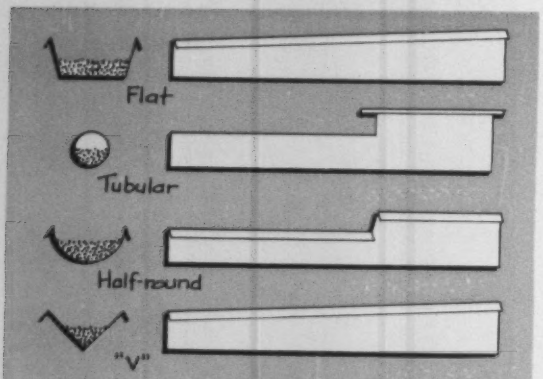


Fig. 15—Standard tray shapes for vibratory feeders are indicated by these sketches. Special trays are readily available to meet particular requirements.

units compare favorably with all but the simplest types.

Virtually all vibratory conveyors are specially designed for specific applications, but they are usually constructed largely of standard subassemblies. Vibratory feeders with trays up to 6 feet long are available as off-the-shelf items. Feeders with longer trays are available on a special basis. Vibratory feeders can be ganged in tandem to provide even longer units. Such units are, of course, special and frequently overlap into the category of conveyors.

Primary advantages of vibratory feeders and conveyors are their simplicity and inherent ability to perform other operations. Additional advantages and also some disadvantages of such units are listed in TABLE 5. All vibratory conveying or feeding devices have the following inherent characteristics: 1. Tendency to spread material being conveyed. 2. Close control of feed rate. 3. Agitation of material being moved. 4. Abrupt discharge of material in space.

The feed rate or output of a vibratory conveyor can be controlled very closely by controlling the frequency or amplitude of vibration. In the pneumatic-hydraulic units, control is usually effected by changing the frequency of vibration with changes in pressure. In the electromechanical types, control is through changes in either frequency or amplitude, but in the electromagnetic types, control is always effected by changing the amplitude. The electromagnetic types are the simplest to control, and with these types the widest range and smallest increments of control are possible.

Vibratory feeders and conveyors can handle hot or corrosive materials readily. Standard units are usually provided with carbon steel trays, but, where required, they may be provided with trays of any other metal, trays lined with glass or other materials, or trays designed to circulate hot or cold fluids to transfer heat to or from the trays. The critical operating parts of vibratory feeders and conveyors may be, and usually are, located some distance from the discharge point of the feeder. This provides an advantage in many applications where high temperatures, corrosive conditions, or access limitations pro-

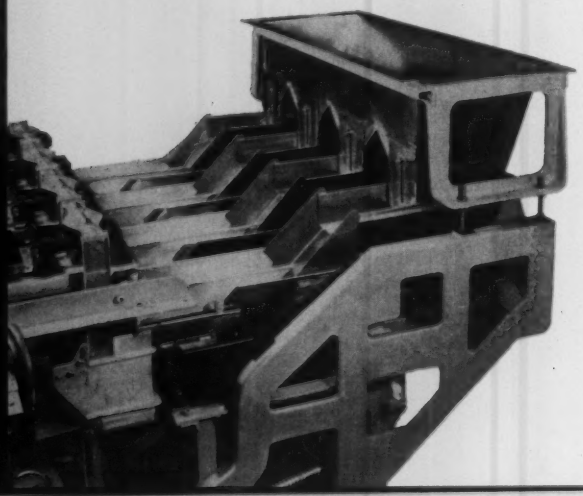
In this unit three vibrators in parallel drive a single wide tray. Tray in this instance is lined with Carrara glass to prevent sticking of the material handled.

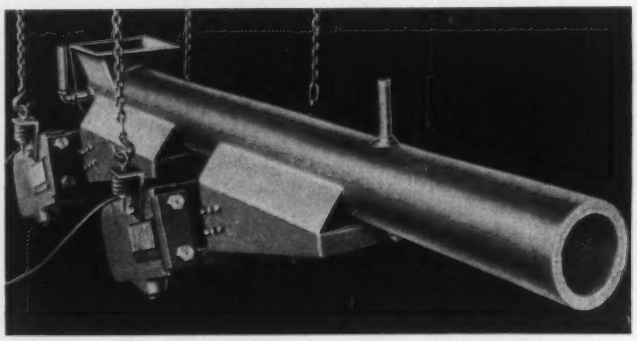
Courtesy, Syntron Co.

Fig. 16—Some of the possibilities in combining standard and custom elements are embodied in these units.

Eight linear feeders are combined in this installation so that two feeders in tandem supply material in each of four parallel lines to an automatic packaging machine. First feeder in each line delivers material from a hopper to the second feeder, which in turn feeds the material to the weighing elements of the machine.

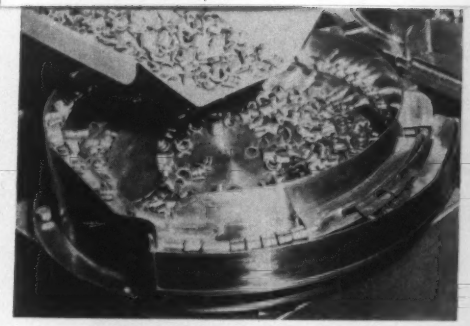
Courtesy, Hayssen Mfg. Co.





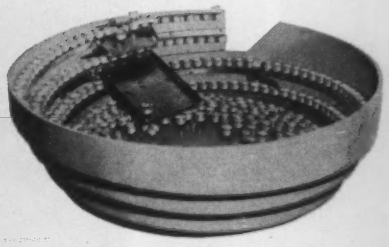
Courtesy, Syntron Co.

This unit uses two vibratory elements to drive a single tubular tray and is designed for suspension from overhead supports. The tray is a water-cooled design to handle hot materials.



Courtesy, Moore Equipment Co.

Helical feeder in this unit has a bowl that is tooled to feed and orient automobile engine valve keys.

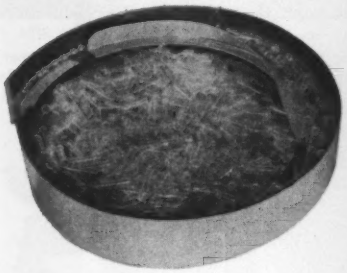


Courtesy, Perry Equipment Co.

More than one track can be provided in a single bowl where delivery rates exceed capacity of a single track. Bowl of this feeder has two separate tracks from which incandescent lamp bases are fed at a rate of 100 bases per minute per track.

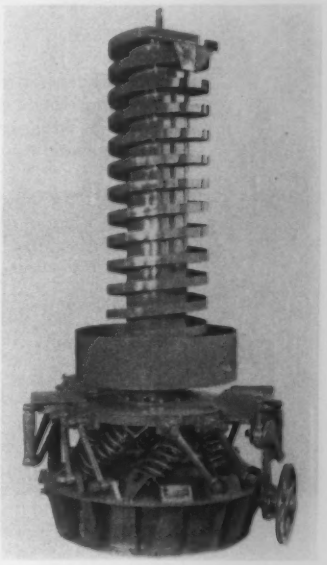
Courtesy, Perry Equipment Co.

Even very difficult, entangling shapes such as springs can be successfully fed, within limitations, by vibratory units. This example is a 30-inch bowl that feeds springs 1½ inches in diameter at a rate of 1200 pieces per hour.



Glass forms for electronic products are fed and oriented at a rate of 300 pieces per minute by this helical bowl unit.

Courtesy, Perry Equipment Co.



This helical conveyor has a track 20 inches in OD and 75 inches in height. Rise is 5 inches per turn. An electromechanical unit, it requires a 1 hp motor. It receives a random feed of plastic blanks and delivers them in single file to an extrusion machine at the rate of 1000 blanks per hour. The uncured plastic must be handled very gently to avoid breakage.

Courtesy, Carrier Conveyor Corp.

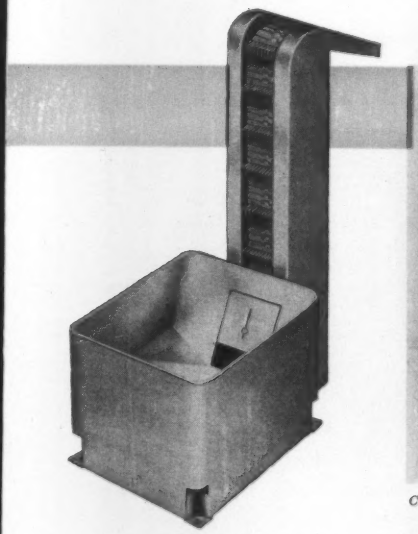
Fig. 17—Specific application examples for helical vibratory feeders illustrate some of the wide range of products handled by such units.

hibit the location of operating elements in close proximity to the discharge point.

For packaging and weighing operations, it is often desirable that the feeding element cut off as abruptly as possible. The cut-off characteristics of vibratory units are considerably superior to those of other common units.

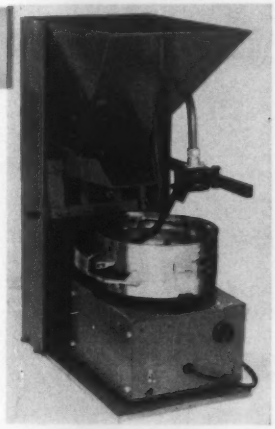
The primary disadvantage of vibratory feeders and conveyors is the highly specialized know-how required for the proper design and application of such equipment. Relatively little of this know-how has been disseminated among the users of such equipment, and misapplications and unforeseen problems are not uncommon.

Upward slope of the conveying path on vibratory units is limited primarily by the characteristics of the material being handled. This is true of both the helical and linear types. With the helical type, however, the maximum elevation to which materials may be raised is less limited; the individual turns may have a low slope and a large number of turns may be used to achieve the desired height. As a general rule, the upward slope of the conveying path is limited to a maximum of 15 degrees above the horizontal. This rule is subject to modification depending on the material and the size and type of feeder or conveyor involved. Trays or troughs of vibratory equipment are subject to wear depending upon the characteristics of the material handled and the par-



Courtesy, Perry Equipment Co.

Example of combination of vibratory units with other handling equipment is this packaged vibratory hopper and elevator for handling small parts. The vibratory unit assures continuous flow of parts to the elevator.



Courtesy, Moore Equipment Co.

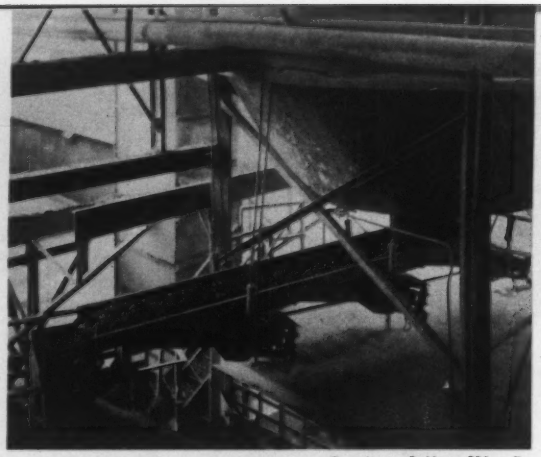
Helical vibratory feeder in this unit has specially tooled bowl and automatic auxiliary hopper system. Sensing arm is responsive to level of parts in bowl. It controls the small linear feeder under the auxiliary hopper to maintain a preset level of parts in bowl.

ticular vibratory device selected. Not all of the materials that are commonly considered abrasive produce wear on a vibratory feeder tray since the material is moved by a tossing action rather than a sliding effect.

In general, vibratory units are among the most gentle means of handling fragile materials. However, under rare circumstances, vibratory equipment may damage the material or objects being handled. Such damage is dependent upon the fragility of the material or objects, the design of the vibratory tray, and the amplitude at which the unit is operated.

Applications of vibratory devices for simply agitating uses and for combinations of handling, agitating, and other functions will be presented in the final article of this series.

Fig. 18—Characteristics of vibratory units for linear conveying and feeding make them also adaptable for handling a wide range of material as indicated by these applications.

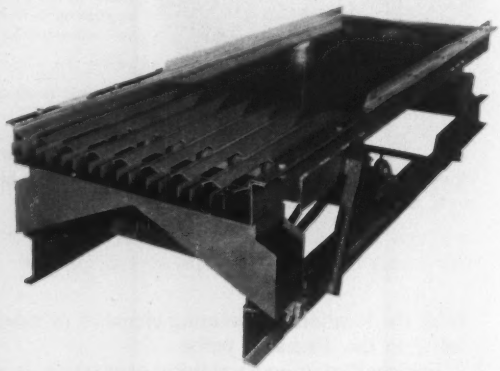


Courtesy, Jeffrey Mfg. Co.

Oyster shells constitute a sharp, wet, and abrasive material that is handled in this installation by three vibratory feeders in tandem. The complete unit is long enough that it can also be considered a conveyor.

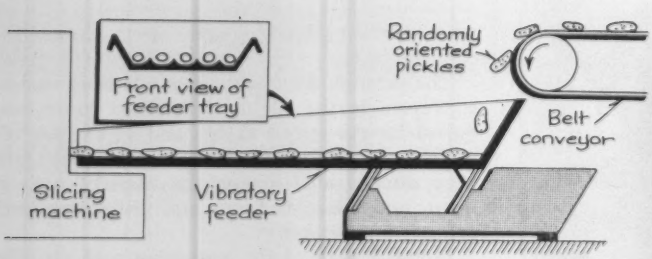
Courtesy, Jeffrey Mfg. Co.

This installation handles hot castings and provides two 90-degree changes in material movement with only a small change in the level of the material being handled.



Courtesy, Carrier Conveyor Corp.

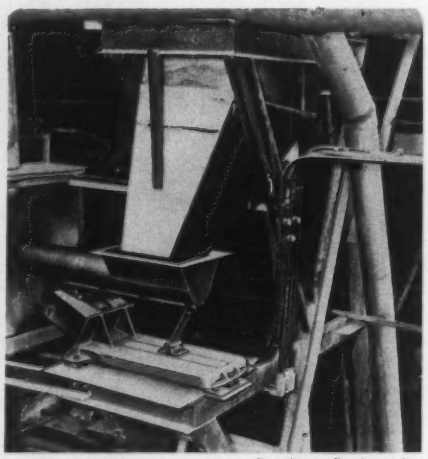
Conveyor shown orients and feeds fragile glass globes to tracks over which they pass to machines for evacuating, gas filling, and attaching of bases. Unit receives globes dumped randomly from hampers, and can continuously orient and feed the globes without breakage. Chutes at each side of discharge end carry off glass from globes broken in dumping.



Sketch shows vibratory feeder with special tray used to orient and feed pickles to a slicing machine.

Low headroom was a big factor in this installation which carries punchings and trimmings away from a press. Only 6 inches of headroom were available in the limited space under the press.

Courtesy, Carrier Conveyor Corp.



Courtesy, Syntron Co.

Heat and accessibility were factors in feeder selection for this installation to feed enameling frit. Note that the vibrating elements are well removed from the discharge point of the feeder.

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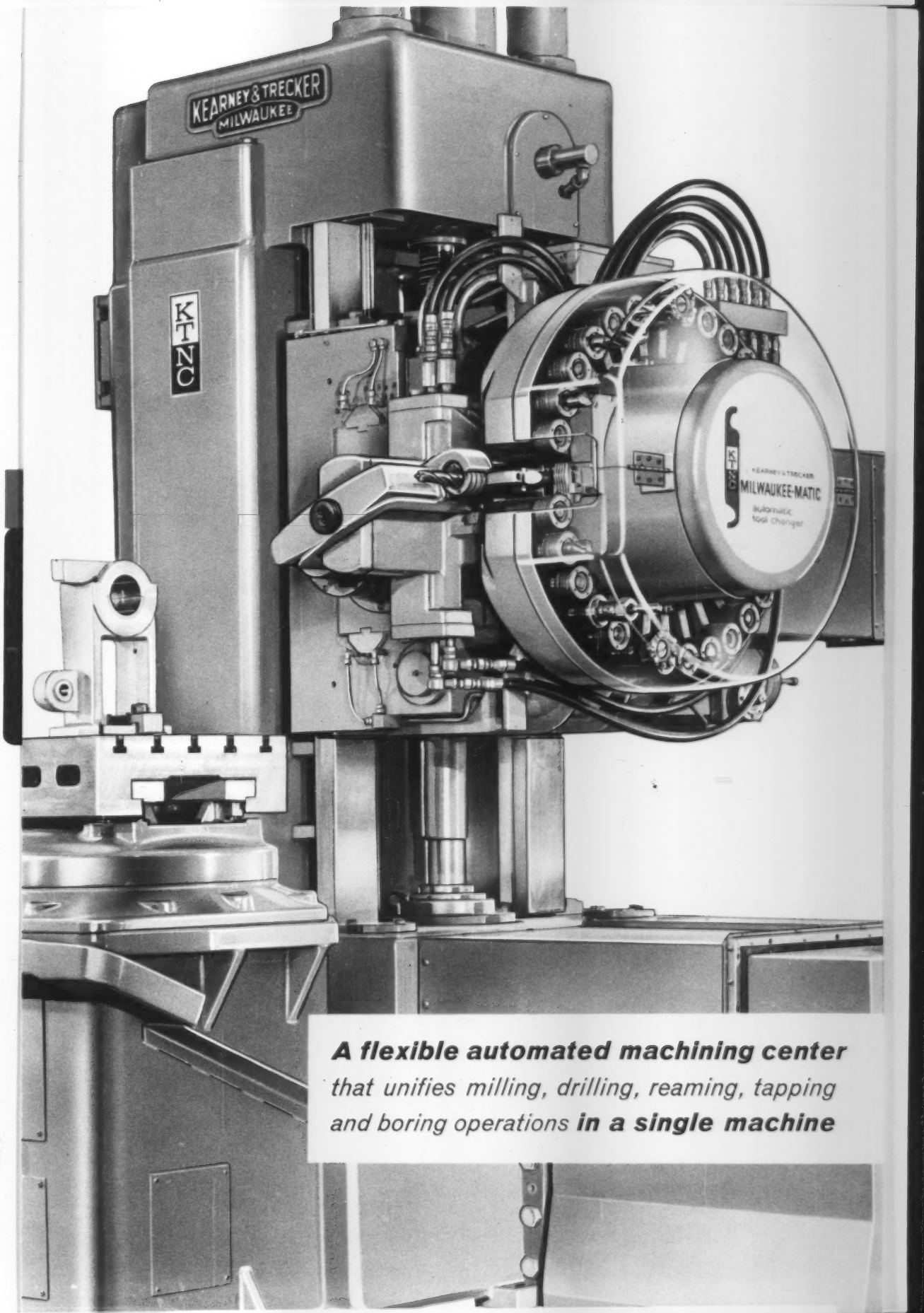

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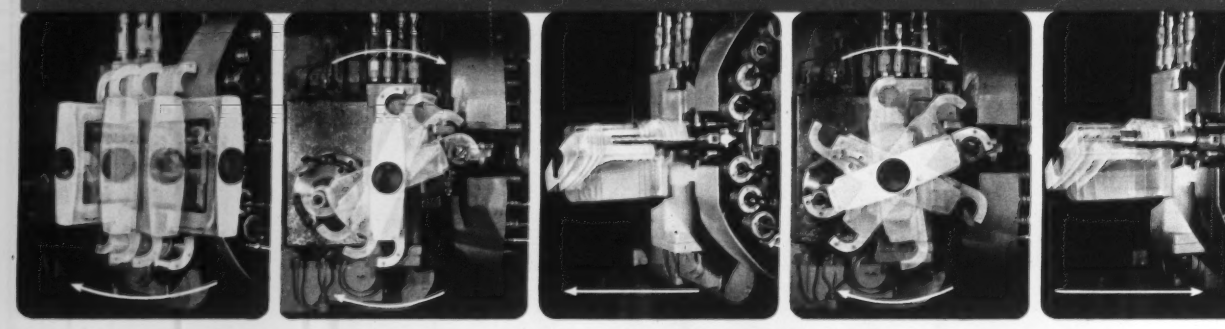

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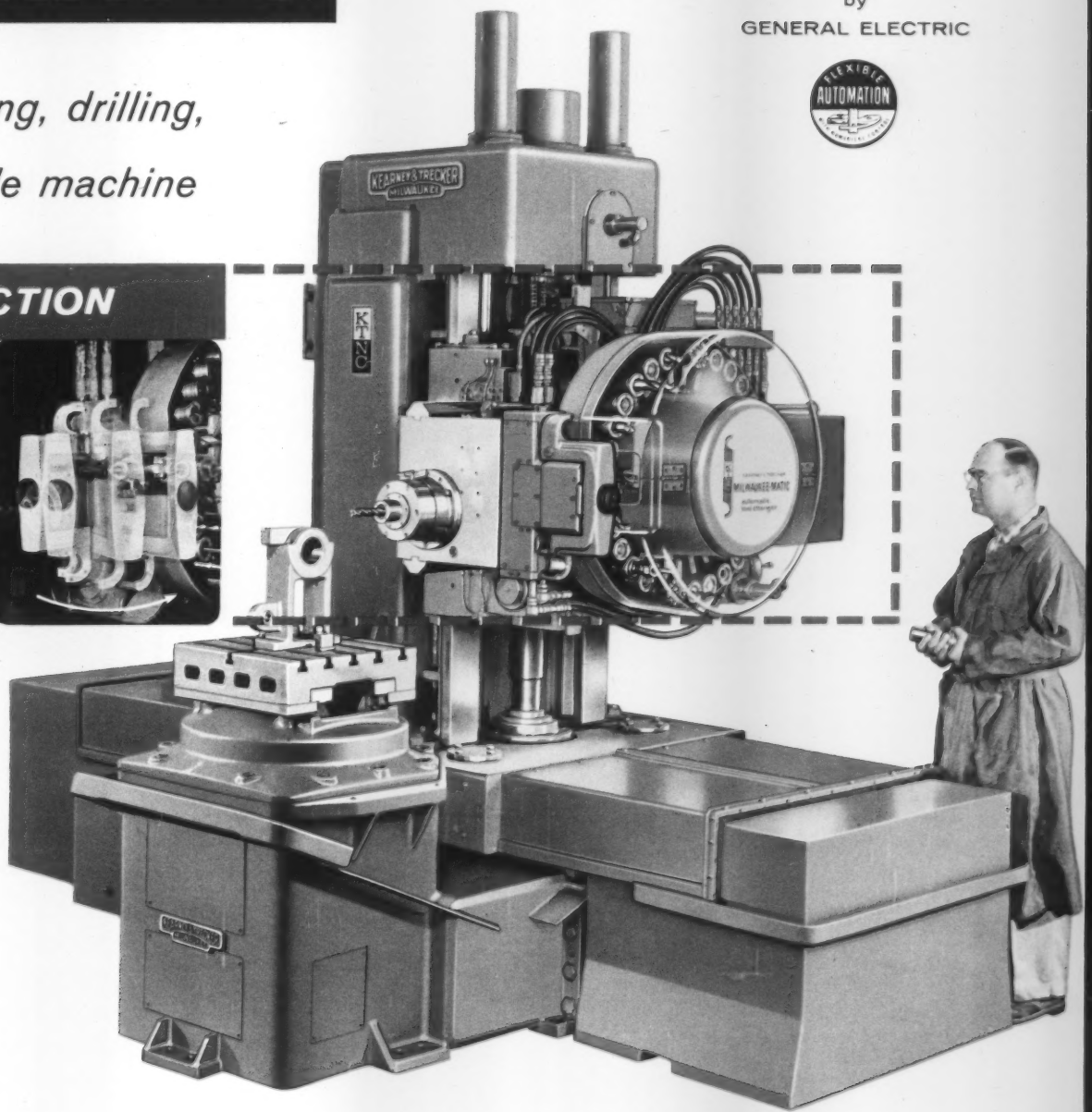

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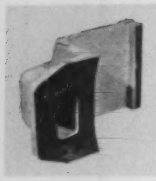

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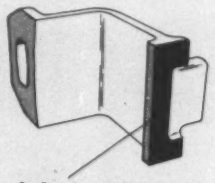
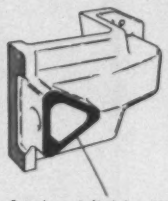


B. Rough and finish mill one surface. Time, 1.36 min.

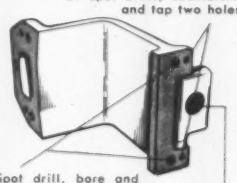


C. Rough and finish mill one surface. Time, .89 min.

D. Spot drill, bore and ream two holes.

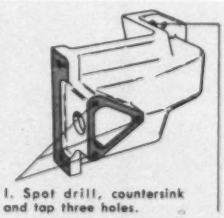
E. Spot drill and drill 3 holes. Time, 3.42 min.

G. Spot drill, countersink and tap two holes.



F. Spot drill, bore and ream two holes.

H. Spot drill, drill and bore one hole. Time, 4.19 min.



I. Spot drill, countersink and tap three holes.

J. Counterbore three holes (in back.) Time, 3.00 min.

Only one single holding fixture and one set-up required to perform 49 operations described above.

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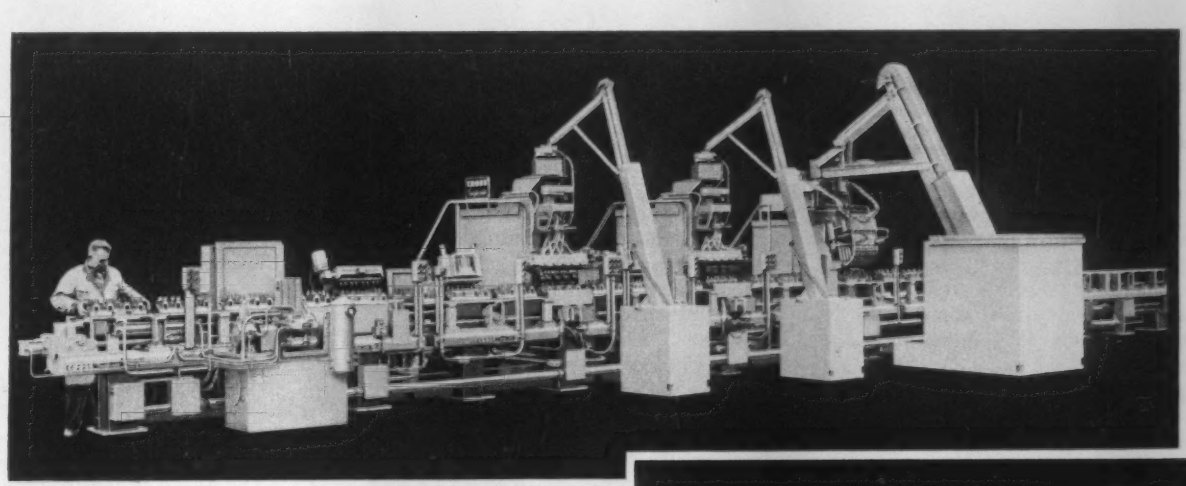
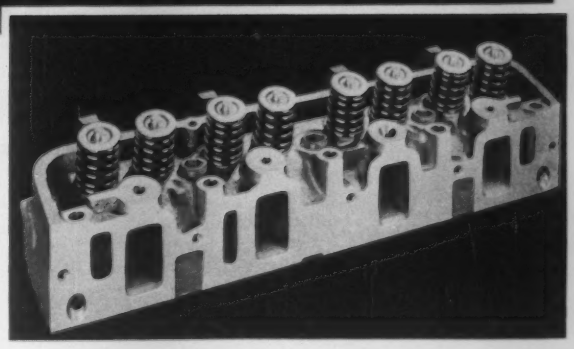


Over-all view of 29-station transfer machine that assembles valve components in V-8 engine cylinder heads. Production rate is 310 cylinder heads per hour.



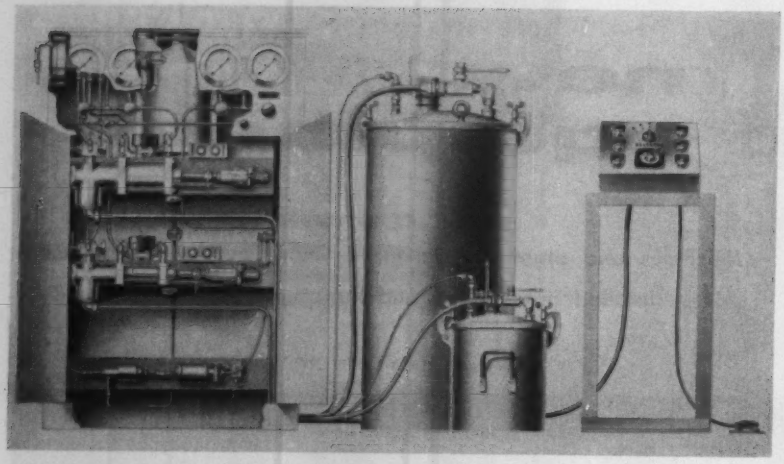
Grommets, valve springs, spring retainers, spring retainer sleeves, and valve locks are automatically assembled to valves preplaced in cylinder heads.

Assembly Machine Uses Building-Block Units

CONSTRUCTED on the building-block principle, 29-station in-line transfer machine is capable of assembling valve components to V-8 engine cylinder heads at a rate of 310 per hour. All machine parts, including tooling details, are toleranced for ready replacement. A feature of the machine, designed by **Cross Co.**, 17801 Fourteen Mile Rd., Detroit, Mich., is the transfer mechanism which lifts and carries the parts between the stations, eliminating the need for individual pallet fixtures.

In operation, cylinder head castings with intake and exhaust valves in place are automatically loaded at the first station. At stations 3, 4, and 5, rubber grommets are placed over the valve stems. Station 7 inspects for valve faults and grommet positioning; if necessary the heads are removed, repaired, and returned to stations 8, 9, and 10. Valve springs, spring retainers, and spring retainer sleeves are automatically assembled at stations 11, 13, and 15. At stations 17 through 23, valve locks are automatically assembled, with standby units for manual assembly at stations 19 and 23. All valves are "popped" at station 25 before the finished assemblies are unloaded at stations 27, 28, and 29. Flexibility for changes in engine design, and to accommodate additional assembly stations, is inherent in the building-block type of construction employed.

Circle 401 on Page 129



Mixing, Metering System Handles Reactive Resins

Item 402

Equipment for proportional metering, mixing, and metered dispensing of liquids such as multicomponent reactive liquid resins has many industrial applications. It can be used for laminating, mat molding, matched die molding, plastic tooling, adhesives and sealers, casting and embedment, and protective and sealant coating. The equipment is furnished as an integrated system mounted on a metal frame and enclosed in a sheet metal housing. The equipment is sealed and the liquid formulation components are under pressure during operation. Pressurization of each ingredient reservoir is individually controlled by an adjustable pressure regulator which is equipped with a pressure indicating gage. Air pressure applied in the reservoirs moves the liquid component materials into their individual metering elements at flow rates required to maintain volumetric efficiency. Homogeneity of the mix is assured by the high rate of shear produced and the feeding of the mix components to a mixer-reactor in a continuous proportion.

The system is designed to control material flow paths within the mixer-reactor; no reactive mix can reach and freeze the reactor seals. The mixer-reactor is jacketed for either heating or cooling of the reactive mix which flows through the mixer-reactor in thin films. An average rate is 120 dispensings per minute. **Mitchell Specialty Div., Industrial Enterprises, Inc.**, Edmund & Shelmire Sts., Philadelphia 36, Pa.

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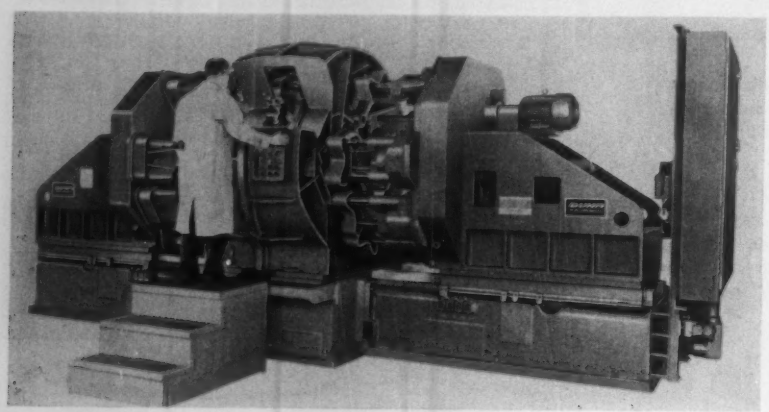

Multioperation Indexing Machine

Item 403

Machine is capable of drilling, boring, reaming, tapping, and chamfering hydraulic valve bodies of 36 different sizes, with holes in various locations. Machine is a double-end trunnion type with two horizontal hydraulic feed units. Feeds are set by a selector switch. Standard cycle of a tool head is rapid advance, coarse feed or fine feed, positive stop, dwell, and automatic reverse.

All tooling data are put on spindle-layout sketches. One sketch identifies all the spindles and tools for one head used for production of one part. Tables are included on the drawings to indicate which tools are to be used. In operation, the workpiece is loaded and clamped, then the operator presses two index pushbuttons. The trunnion indexes one station and the heads are automatically fed in by a platen cylinder.

Rapid advance of the tool platen toward the work is obtained by allowing the hydraulic fluid in the rod end of the feed cylinder to pass to tank without restriction. Before the tools contact the work, however, a dog on the tool platen mechanically operates a valve that closes off this path. At the same time, a solenoid valve is opened and the fluid exhausts through one of two coarse-feed flow control valves. The proper valve is preselected by a selector switch during setup of the machine. When coarse feed is completed a deceleration valve is operated and fine feeding ensues. Positive stop, dwell, and automatic reverse actions complete the cycle. **Buhr Machine Tool Co.**, Ann Arbor, Mich.

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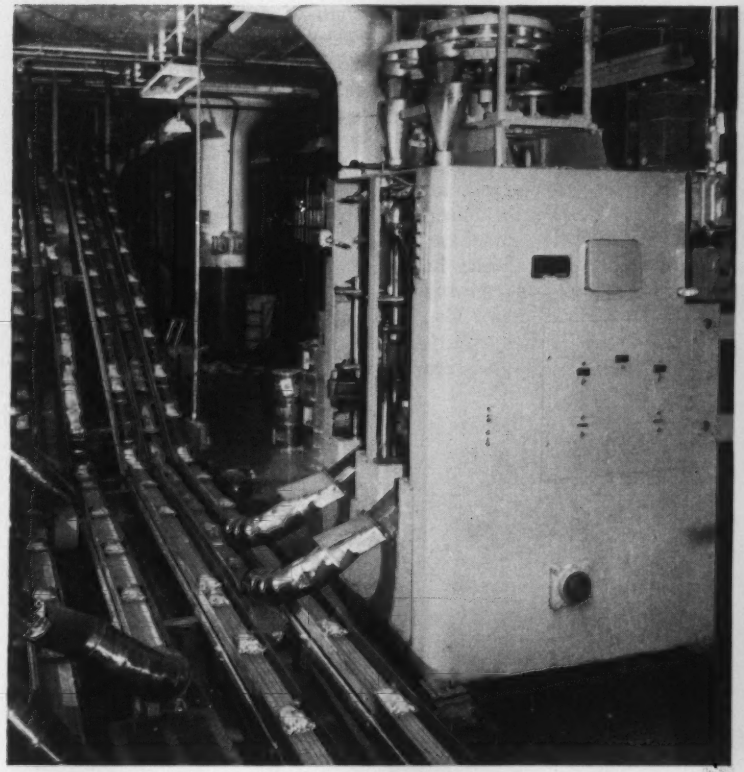
Diode Tester

Item 404

Machine is capable of automatically sorting up to 3000 diodes per hour into as many as 16 classifications. Model 276 is adaptable to existing test equipment and can accommodate a four parameter forward-to-back resistance test se-

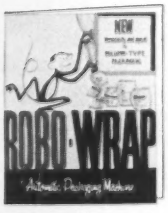


Why General Mills chose Robo-Wrap for Pick-A-Pack

This new Robo-Wrap at General Mills' Chicago plant will soon be joined by 2 more machines—because it has been proved that Robo-Wrap increases the efficiency and economy of their packaging operation.

The Robo-Wrap forms, fills and seals pillow packages. Under production line conditions at General Mills, the Robo-Wrap cruises at 100 bags a minute and can run at 120 . . . it provides a better seal and fewer rejects even at these high speeds because its unique hand-over-hand action holds jaws in sealing position for a longer time . . . it minimized work stoppages due to torn paper roll stock because the combination mechanical and hydraulic jaws exert a strong, jerk-free pull . . . it is easily adaptable to handle a variety of other products.

Robo-Wrap packages in cellophane, paper, poly, plastic or laminates. See how it can answer your needs for speed, dependability, easy maintenance and adaptability.



Write for Illustrated Robo-Wrap Folder that demonstrates features and advantages important to you.

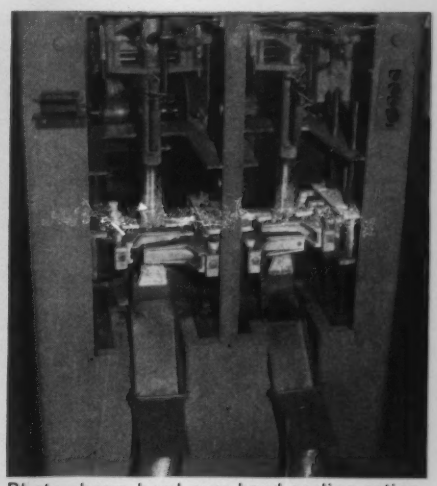
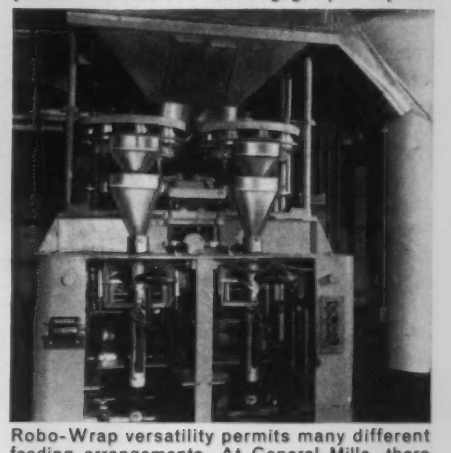


Photo shows hand-over-hand sealing action. Lower jaws, now disengaged, start to go up and pass on the outside of still-engaged pair of jaws.



Robo-Wrap versatility permits many different feeding arrangements. At General Mills, there is a volumetric feeder leading from storage hopper supplied from floor above.

General Mills Pick-A-Pack Package offers five tasty breakfast foods—Wheaties, Cheerios, Kix, Trix, and Sugar Jets—in one attractive carton.

LYNCH
CORPORATION
Anderson, Indiana

Circle 672 on Page 129

quence without rehandling. Diodes are automatically transported from

hopper to bins. The only manual operation is the refilling of the hopper in the handling machine and removing the filled bins. Unit will handle parts having maximum dimensions of 0.265 inch long by 0.105 inch in diameter with $1\frac{1}{8}$ inch lead length. It is rated for 115 v ac, 2 amps. **Electronic Control Systems Div., Stromberg-Carlson Co.**, 2231 S. Barrington Ave., Los Angeles 64, Calif.

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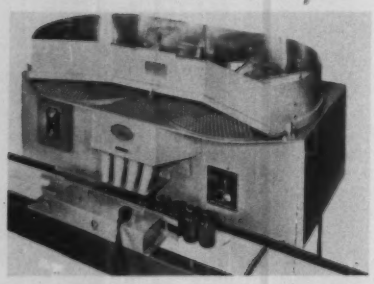
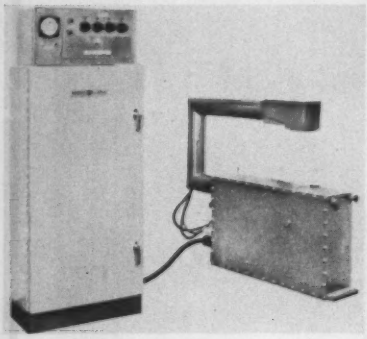


Tablet & Capsule Counter

Item 405

Unit is suitable for counting coated tablets, gelatine capsules, and some hard compressed tablets. It features twin rotating discs which collect tablets or capsules in perforated openings to fill up to four bottles at a time. Speeds of up to 100 bottles of 100 tablets per minute can be obtained. Speed of the rotating discs is adjustable from 2 to 12 rpm. The discs are made of anodized aluminum to eliminate warping, and are set in a horizontal plane. This permits the use of a special multiple brush arrangement which forms six wells or compartments of tablets for each disc. Dual hoppers provide for two types of tablets to be counted into the same bottle. If an oversize gelatine capsule sticks in a counting hole, a detection device will stop the machine. If there is a holdup in the bottle supply, an automatic trip on the bottle gating mechanism will stop the machine. The gating mechanism can be mounted over a conveyor running between 15-30 fpm. **Burnet Co.**, East Midland Ave., Paramus, N. J.

Circle 405 on Page 129

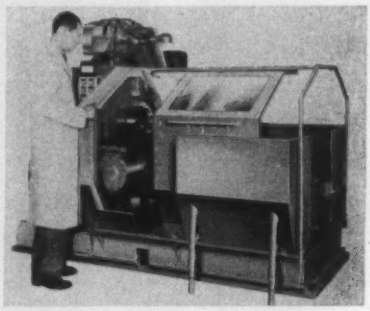


Thickness Gage

Item 406

Designed for use in hot and cold strip rolling mills, x-ray thickness gage is capable of gaging steel up to 600 mils thick. Model 600 features transistorized plug-in electronic panels and a dual-beam x-ray system. Components in the unit include: Operator's control, electronic equipment cabinet, and gaging head. Operator's control has a digital thickness setting system and deviation indicator. Controls are: Zero adjust, zero standard, selector switch, thickness adjustment, and in-low deviation range switch. A test circuit in the equipment cabinet contains 14 separate check points. Deviation regulator and amplifier consist of plug-in printed circuit transistor units. The gaging head has two parts; a measuring head and a generator head. Measuring head contains an upper ion chamber and electrometer amplifier. Generator head contains an oil filled x-ray tube head with HV transformer, filament transformer, and x-ray tube; a wedge mechanism with gage wedge servo drive, linear potentiometer, and ion chamber; and a replaceable heat exchanger and internal cooling fan. **General Electric Co.**, X-Ray Dept., 4855 W. Electric Ave., Milwaukee, Wis.

Circle 406 on Page 129



Automatic Turret Lathe

Item 407

Capable of high-speed production of tough alloy components, Model 3E-15 features a 10-inch chuck capacity and $11\frac{1}{2}$-inch swing over base ways. Production runs of as few as 25 pieces can be handled on a fully automatic basis. Front and rear cross slides are individually adjustable along the base ways. A control mechanism permits the operator to set the front or rear slide for *On-Time* or *Delayed* movement relative to any of the 6 turret faces by turning a selector switch. There are 4 automatic speed changes and 6 automatic feed changes for each set of change gears. **Potter & Johnston Co.**, Pawtucket, R. I.

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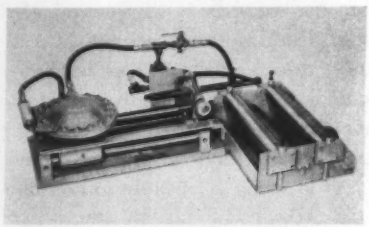


Pneumatic Stock Feeder

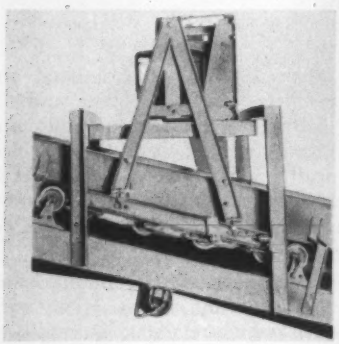
Item 408

Device is capable of feeding coiled materials to punch presses. Three models are available to accommodate stock widths from 1 to 6, 12, 18, 24, or 30 inches and stock thickness up to 0.090 inch. Maximum stroke lengths of the air feeders are adjustable from 1 to 6, 12, 18, 24,

30, or 36 inches.

The feeder is a portable type unit, can be moved from press to press. It is mounted directly to a bracket on the side of the press. The speeds of both the forward and return strokes can be independently adjusted by built-in speed control valves. A feature of the unit is that the hydraulic check is automatically filled when needed from a reservoir. An indicator rod on the reservoir indicates when this element needs refilling. **Special Engineering Service Inc.**, 8161 Livernois Ave., Detroit 4, Mich.

Circle 408 on Page 129



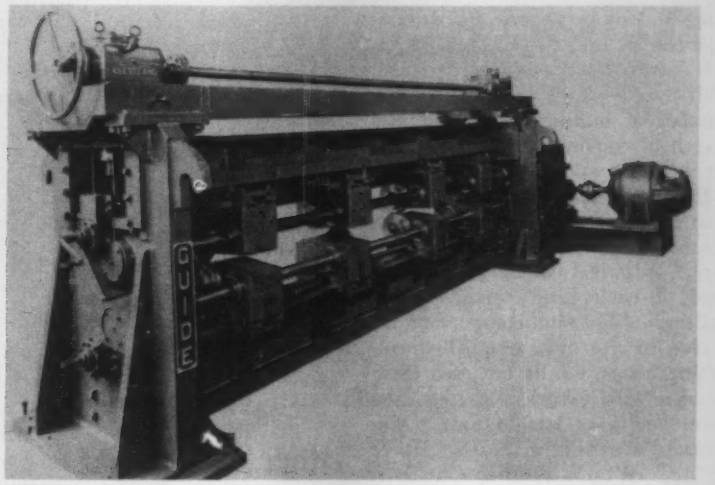
Belt Conveyor Scale

Item 409

Pneumatic scale can be installed on existing flat-belt or trough-type conveyors. It is adaptable to either fixed or variable speed conveyors. The scale can be used in weighing systems for indicating, recording, totalizing, proportioning, and programming the rate of flow of material.

Unit is mounted above the conveyor on a platform supported by four vertical members. A-shaped hanger arms that support idlers under a section of the conveyor belt transmit the weight of material passing over the section to a pneumatic weight transmitter. A flexural frame arrangement decreases the effects of side thrust and eccentric loading on the conveyor, and delivers a single force component to the transmitter. The pneumatic signal from the transmitter is delivered to readout units which perform the automatic control functions. **Weighing and Control Components Inc.**, 632 Lincoln Rd., Hatboro, Pa.

Circle 409 on Page 129



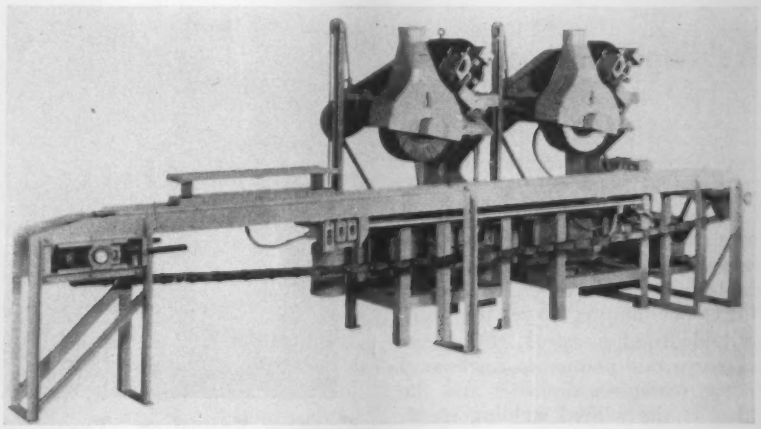
Arborless Slitter

Item 410

Model AS-144-1 can handle steel from 11 to 28 gage, with a maximum ultimate shear strength of 45,000 psi, at 300 fpm. Gear-driven knife support housings are used in place of conventional slitter arbors. The housings are supported by bronze-lined machined ways, thus reducing knife deflection. The lower knife support housings are stationary in the vertical plane. The upper knife housings can be adjusted vertically by means of a hand wheel at the end of the machine. Stock widths to 144 inches can be accommodated, and up to four cuts can be made.

During the slitting operation, the knife support housings are clamped securely to the ways. When the position of the knife is to be changed, the clamp is released to permit the knife support housing to slide on the ways. After the clamp has been released, the knife housing can be moved in either direction. No locating collars or shims are needed. The housings can be driven individually or simultaneously by line shafts. **Guide Co.**, Canfield, Ohio.

Circle 410 on Page 129



Reciprocating Buffing Machine

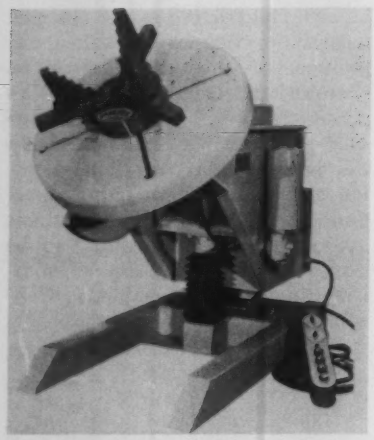
Item 411

Device is designed for both low and high production runs. When used as a continuous buffer for high production runs, it will handle parts up to 4 feet in length. By providing the proper length of conveyor,

short or long extrusions and mouldings can be buffed. In the illustration shown, the machine is equipped with two buffing heads, but any number of buffing heads and any length of conveyor can be supplied for different applications.

Buffing heads are of the full-floating type and balance weights are used to adjust for proper pressure. A swivel adjustment at the base of each head permits cross-buffing. Additional components included in the unit are: Dust collecting hoods, totally enclosed dustproof motors, electrical starters, and *Start* and *Stop* pushbuttons. Motors are available in 5, 7½, 10, or 15 hp. **Wilson Buffing Chuck & Machine Co.**, 22730 Dequindre, Warren, Mich.

Circle 411 on Page 129

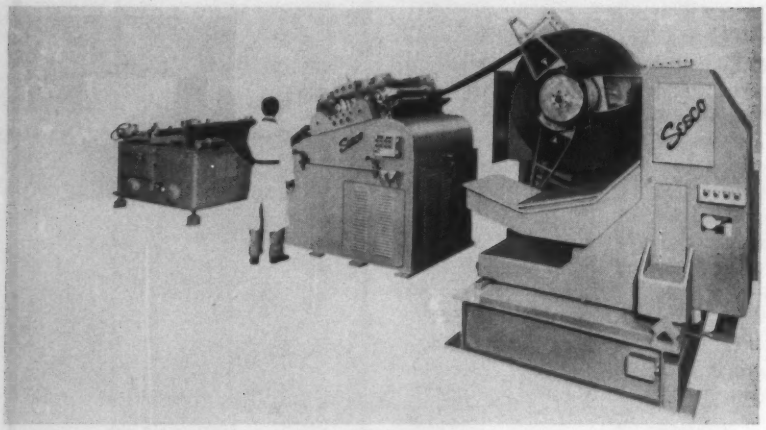


Welding Positioner

Item 412

Device is capable of positioning and automatically rotating various diameter cylinders to be welded. Two calibrated dials are mounted on a pushbutton station. One dial reads work diameter in inches, and the other reads welding speed in inches per minute. To set the proper table rotation speed, the operator turns one pointer to correspond to the workpiece diameter and the other to the desired welding speed. Then the control system automatically correlates table speed, workpiece diameter, and welding speed to give the proper table rpm. **Pandjiris Weldment Co.**, 5151 Northrup Ave., St. Louis 10, Mo.

Circle 412 on Page 129



High Capacity Coil Feed Line

Item 413

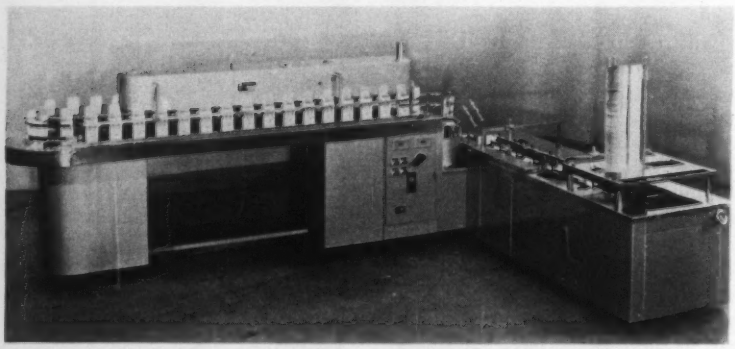
Line of equipment can handle large coils up to 40,000 lb with an OD up to 72 inches, is suitable for feeding into blanking, piercing, forming, and progressive die operations. Equipment in the line includes: Power lift loader, centering reel, stock straightener, and feeder. All units can be controlled by pushbutton.

The loader is mounted on rails, permitting lateral movement. The coil is elevated to obtain proper core alignment and transferred laterally onto the expander arms of the centering reel. The expander arms can handle coils with inside diameters from 18 to 30 inches without the need of adaptors.

Stock straightener is power driven, removes the coil bend and crown for smooth feeding and die operation. The output rolls and lower straightening rolls are electrically power driven, can be individually adjusted. Model shown uses seven straightener rolls to remove the coil bend.

Feeding on the final unit is accomplished by means of a crosshead, which clamps hydraulically and is reciprocated along ground guide bars by a hydraulic cylinder. This unit is self-contained, can be moved from one press to another. It is adaptable to feed from the left, right, front, or back. **Sesco Inc.**, 8881 Central Ave., Detroit 4, Mich.

Circle 413 on Page 129



Carton Forming, Transfer, and Filling System

Item 414

Semiautomatic cartoning system is capable of maintaining cartons under continuous mechanical control, providing access for filling by five operators. System consists of a forming and bottom-closing unit, a transfer unit, and a cartoning unit. In operation, hopper-feed car-

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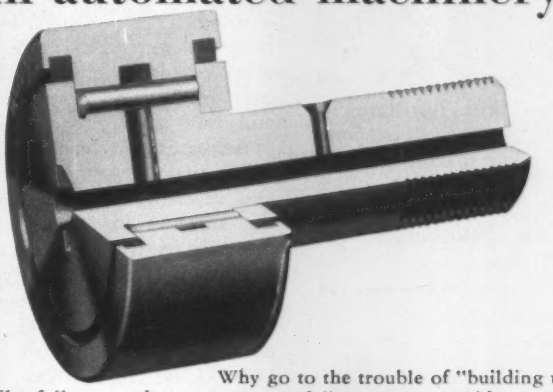
by McGill

CAMROL® bearings...save the cost– and inconvenience–of improvised followers in automated machinery

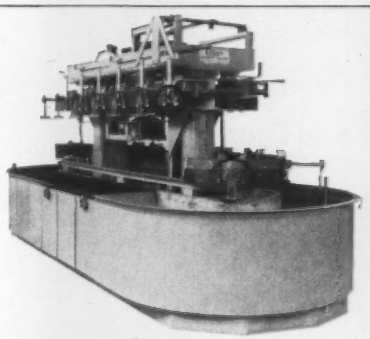


Why go to the trouble of "building up" special roller followers when CAMROL cam followers can provide so many construction advantages in a standard bearing? Select the proper size from roller diameters of ½" to 4" in either the CF (with stud) or CYR (for shaft mounting). It saves time and money when applying roller followers to cam follower, track, guide and support roller applications.

The McGill construction is backed by over 25 years experience with thousands of applications. Selected steel, tested design, special heat treatment and simplified lubrication insures the dependability of CAMROL — the original roller bearing cam follower.

For protected performance, SCF Series Sealed Camrol Bearings provide the added advantages of better lubrication retention and sealing against dust, dirt and other contamination. Frequent relubrication can be avoided.

AUTOMATIC PLATING MACHINES USE CAMROL BEARINGS

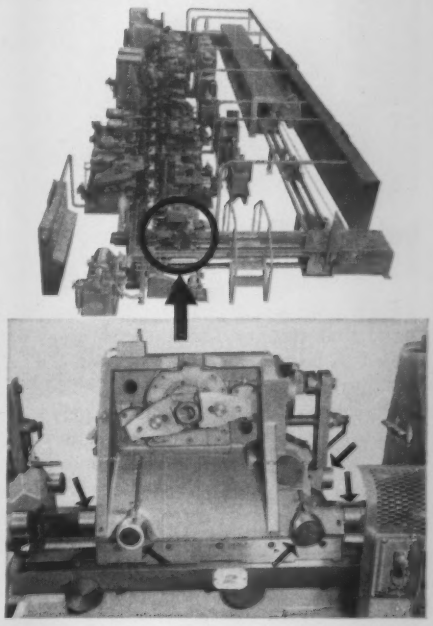


CROWN RHEOSTAT AND SUPPLY COMPANY uses up to 200 Sealed CAMROL cam followers as guide and support rollers in the travel and transfer mechanisms of their cleaning, plating and drying machines. The machine shown here is a CROWN Type "D" Fully Automatic Plating Machine. The CAMROL bearings assure precision action, reduced friction and minimum maintenance. Built-in seals protect the bearings from cleaning and plating solutions.

FOR COMPLETE ENGINEERING DATA ON McGILL PRECISION NEEDLE ROLLER BEARINGS, SEND FOR BEARING CATALOG NO. 52-A

FIXTURES ROLL FREE— and accurately on Sealed CAMROL bearings

Production parts are drilled, milled, bored and tapped in automated systems engineered and built by the BUHR MACHINE TOOL COMPANY. The moving fixtures which hold parts being machined are guided and carried on McGill sealed CAMROL bearings as shown in the close-up below.



By reducing the starting and running friction to an absolute minimum, the CAMROL bearings have made horsepower requirement reductions possible in these systems. Ample load capacity, high resistance to shock loads and integral seals which retain lubrication and keep out contamination have held maintenance down. In the system pictured, 8 SCF-3 CAMROL bearings accurately guide and support each of 28 fixtures. Performance is reported excellent.

engineered electrical products

McGILL®

precision needle roller bearings

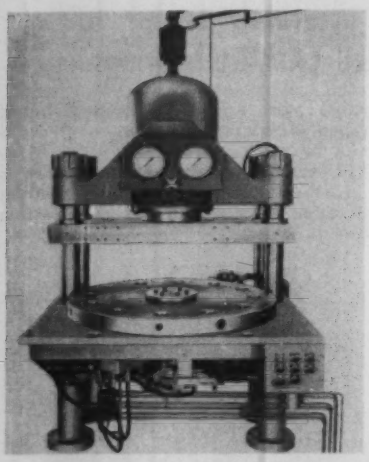
SEND FOR CATALOG No. 52-A

MULTIROL — GUIDEROL — CAMROL

McGILL MANUFACTURING COMPANY, INC., BEARING DIV., 401 N. LAFAYETTE ST., VALPARAISO, INDIANA

tons move in a smooth, continuous motion through a horizontal forming and bottom-closing unit. They are then transferred onto a vertical unit for filling and automatic closing. The equipment handles cartons ranging in size from ¾ x ¾ x 2½-inch to 4 x 4 x 12-inch. Its units are available separately or as a complete system. **Bivans Corp.**, 2431 Dallas St., Los Angeles 31, Calif.

Circle 414 on Page 129



Indexing Press

Item 415

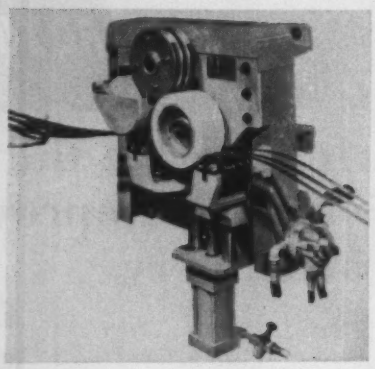
Hydraulic machine features automatic dial feed or indexing, is designed to fabricate precision powder metallurgy pieces. Model 57-2449 will produce up to 15 pieces per minute on a 4-second cycle. The approach, press, and dwell times are independently adjustable. A heavy steel turntable on the 154-ton press is equipped with multiple die stations. A positioning lock device automatically locates each station to within 0.0003-inch accuracy. Automatic interlocks provide fail-safe performance. **Rucker Co.**, 4720 San Pablo Ave., Oakland, Calif.

Circle 415 on Page 129

Continuous Printer

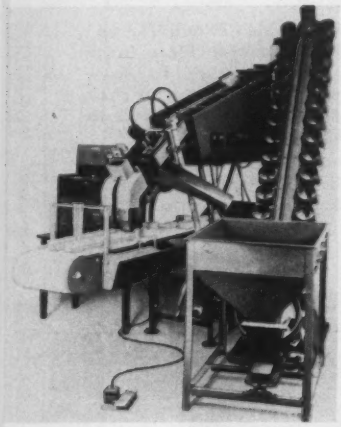
Item 416

Offset printing unit can simultaneously print three coils of steel or other stock with characters from ⅛-inch to ¾-inch high. Device has three individual type wheels which can print different data or identical data. Printer is friction driven by the material passing on



the production line, furnishing a printing speed that will correspond to line speed. The machine can be adjusted to accommodate a range of band widths and stocks. **Jas. H. Matthews & Co.**, 3945 Forbes Ave., Pittsburgh 13, Pa.

Circle 416 on Page 129



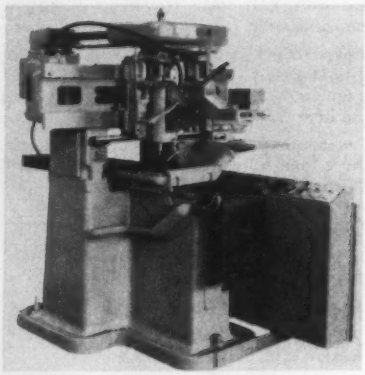
Small Parts Counter

Item 417

Machine can feed and count all sizes and shapes of screws, bolts, nuts, and other fasteners up to ½-inch in diameter and 2 inches in length. It is capable of handling up to 4000 screws per minute and up to 6000 nuts per minute in the smaller sizes. Any count from one to 1000 can be obtained by setting the dials on an electronic instrument.

A bulk-hopper supplies parts to a vibratory feeder underneath, which feeds the parts at a controlled rate into the buckets of an elevator. At the top, the elevator buckets discharge the product down a chute into a second vibratory feeder, which drops them into an orienting mechanism. The orienting device consists of two approximately parallel rollers which revolve so that the adjacent inner portions move upward. These rollers orient and feed the product down to a pair of counting rails. Parts not properly oriented are rejected back into the hopper. A photoelectric pickup unit positioned at the end of the counting rails registers each part as it passes into a gate housing. As the part leaves the rails and enters the gate housing, it is diverted by means of a pivoted gate out through one of two funnels and into a container. When the preset count is reached, the gate snaps over, separating the product and diverting the next batch into the adjacent funnel and the container beneath it. As one container is filled, it is automatically released down the conveyor and replaced by an empty container. **U. S. Engineering Co.**, 40-24 22nd St., Long Island City, N. Y.

Circle 417 on Page 129

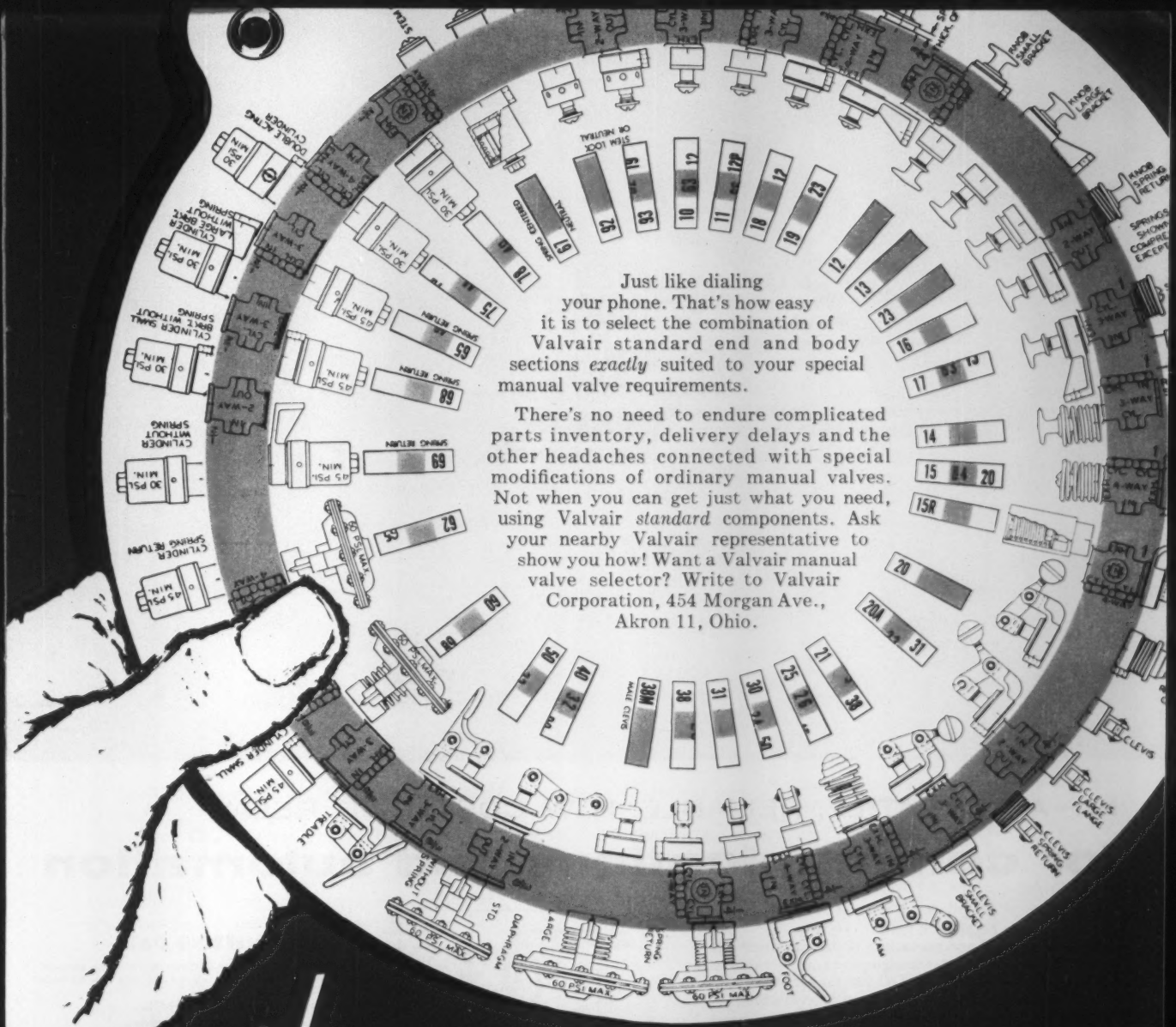


Vertical Profiler

Item 418

Vertical unit operates from a sheet steel profile template to produce any two-dimensional straight-line or irregular contour shape with speeds up to 60 ipm. Profiler features two spark gap sensing elements in the tracing head which activate the table and slide when stylus deflection is only 0.0002 inch. Other features of the machine are: It can trace at a preset constant surface speed, and it has zero tracer pressure which permits the use of soft steel templates. **Pratt & Whitney Co. Inc.**, West Hartford 1, Conn.

Circle 418 on Page 129


Just like dialing your phone. That's how easy it is to select the combination of Valvair standard end and body sections *exactly* suited to your special manual valve requirements.
There's no need to endure complicated parts inventory, delivery delays and the other headaches connected with special modifications of ordinary manual valves. Not when you can get just what you need, using Valvair *standard* components. Ask your nearby Valvair representative to show you how! Want a Valvair manual valve selector? Write to Valvair Corporation, 454 Morgan Ave., Akron 11, Ohio.

Valvair *manual valves*

. . . unlimited combinations using standard components!

Find us fast in the 'Yellow Pages'

Compare . . . and you'll buy

Valvair

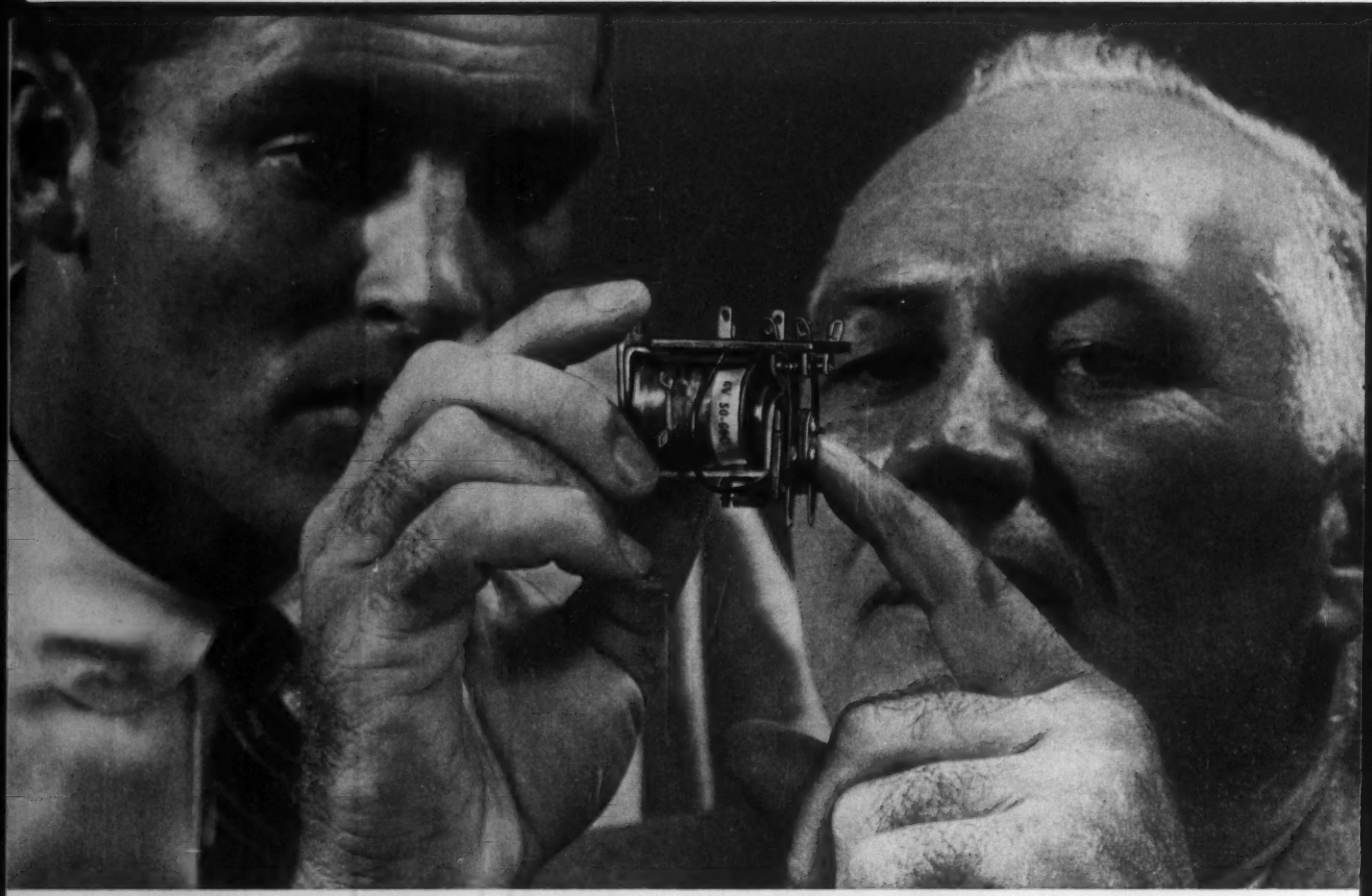
SALES AND SERVICE FROM LOCAL STOCK

Representatives in principal cities throughout the world

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION

Plants in Akron, Ohio; Coston, Pennsylvania; Birmingham, England; Amersfoort, Holland

Circle 276 on Page 129



KL—A VERSATILE, RELIABLE, LOW COST P&B RELAY

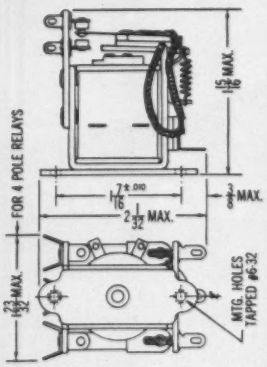
for communications and automation

ECONOMY and versatility distinguish our KL series relays. Contact arrangements are available up to 4 pdt in either AC or DC versions. Sensitivity of 100 milliwatts per movable arm is available.

Stationary contacts and terminals are mounted on a phenolic front of high dielectric strength, thus adding to the utility of the relay. Conveniently located terminals and easy-to-mount base greatly simplify installation on long production runs.

KL relays may be hermetically sealed or furnished in metal dust covers.

This is one of a "family" of fine P&B relays. Others, with similar configurations but various electrical and switching capacities, are shown below. Write or call for more information or see the complete P&B catalog in Sweet's Product Design File.



KL ENGINEERING DATA

GENERAL: Breakdown Voltage: 500 volt rms, 60 cycle between all elements standard 4 pole relay; 1500 volts rms, 60 cycle on special 3 pdt relay.

Temperature Range: −45°C. to +85°C.

Pull-In: Approx. 75% of nominal dc voltage.
Approx. 78% of nominal ac voltage.

Terminals: Pierced solder lugs for two #20 AWG wires.

Enclosures: Metal can 2¾" high x 2⅞" long x 2 11/32" wide with octal plug or multiple solder header.

CONTACTS: Arrangements: up to 4 pdt.

Material: ⅛" dia. gold-flashed silver. (Others available.)

Load: 5 amps @ 115 volts, 60 cycle resistive loads.

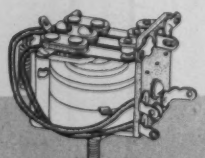
COILS: Resistance: 60,500 ohms max.

Power: 100 milliwatts per movable arm.

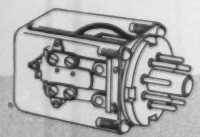
Duty: Continuous; coils will withstand 6 watts @ 25°C.

Voltages: up to 110 volts dc.
up to 230 volts ac.

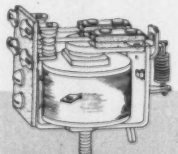
P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



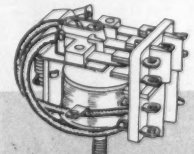
KR SERIES: SMALL, 5 AMP RELAY
Ruggedly constructed for long life and dependability. Available up to 3 pdt.



KCP SERIES: SENSITIVE 3 PDT RELAY
For plate circuit applications requiring low cost, semitive relay. Polyethylene dust cover.



KT SERIES: ANTENNA RELAY
Insulated to minimize RF losses. Designed to switch 500 watts RF input to 300 ohm line.



KA SERIES: GENERAL PURPOSE
Compact, light-duty relay. U/L approved. Meets 1500 volts rms breakdown requirement.

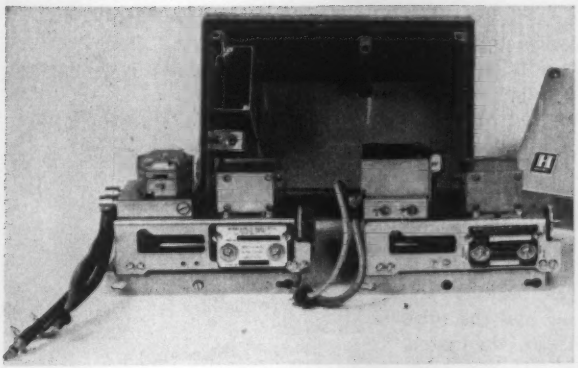
POTTER & BRUMFIELD INC.

PRINCETON, INDIANA • SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY

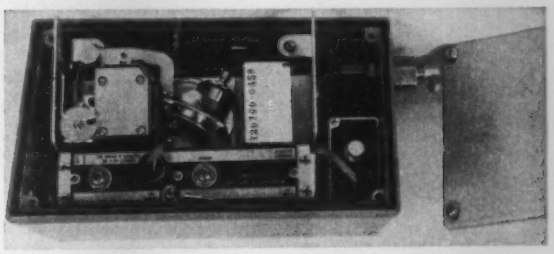
AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems.

For detailed information and literature, use card page 129.



Dual units at left include pressure-to-current transducer and current-to-pressure transducer. Combination can be used to sense a pneumatic signal (3-15 psi) at one location and reproduce it five miles away.



Process pressure-to-current transmitter is actuated by Bourdon tubes or bellows to provide pressure measurements from 10 inches H_2O to 10,000 psi.

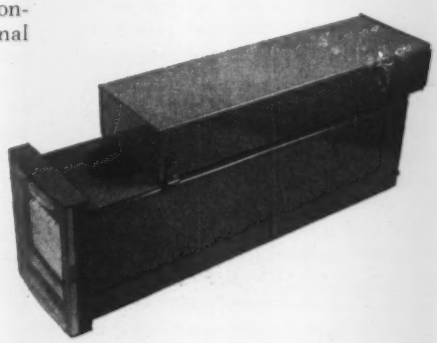
Electrical Control Instruments

LINE of electric instruments, designed by **Minneapolis-Honeywell Regulator Co.**, Wayne & Windrim Aves., Philadelphia 44, Pa., can be used to integrate control systems with data handling, computers, etc. Advantages of an electric control system are said to be: Fast speed of response which is compatible with the response speed of process equipment and data handling systems; long transmission distance (up to 5 miles); and ability to withstand extremes in temperature.

Components in the System

Called ElectriK Tel-O-Set, the two-wire system does not require power at field-mounted transmitters. The system includes transducers, transmitters, receivers, controllers, and actuators (the final control elements). There are several types of transducers in the line of instruments. A pressure to current unit accepts an input signal of 3-15 psi and transmits a 4-20 ma signal. A current to pressure and valve actuator converts the 4-20 ma signal to 3-15 psi pneumatic output. Current to frequency and frequency to current units are available where telemetering is required. There are also several types of transmitters. A millivolt to current unit is used as a temperature transmitter with thermocouple or resistance thermometer inputs. A differential pressure unit provides for the transmission of differential pressure in flow metering or liquid level applications, while a process pressure to current unit provides pressure measurements from 10 inches H_2O to 10,000 psi. A millivolt to pressure unit functions as a link between electrical measuring devices such as stream analyzers, strain gages, and pneumatic systems.

The receivers in the system can be either a recording or indicating type. The electric recorder has continuous indication and recording of the variable, continuous indication of the set point and valve current, and automatic switching and set-point adjustment. As many as three recorders can be mounted on a 19-inch relay rack. Indicator is available in either the milliammeter or servo type. Controllers are available with proportional and automatic reset action or with proportional and automatic reset plus rate action. Controllers are designed so the rate function precedes the reset function. This design permits use of the device in start-up



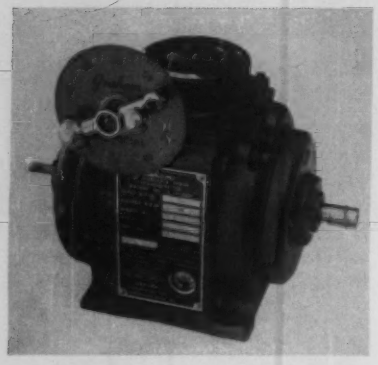
Combined recorder-control station. The controller is mounted on the back of the panel. Recording is on a 4-inch strip chart.

←Circle 675 on Page 129

since the accumulate reset will be removed as the control point is approached. The final control elements in the system can be: An electrohydraulic valve actuator, an electropneumatic valve positioner, or a current to pressure valve operator.

Versatility of the system is displayed by the fact that it can be linked to a number of pneumatic instrumentation and control schemes. When used in existing systems, instrument panels can be entirely electric, pneumatic signals can be transmitted electrically, transmitters can provide inputs to data handling systems, and electric temperature processes can be controlled.

Circle 419 on Page 129

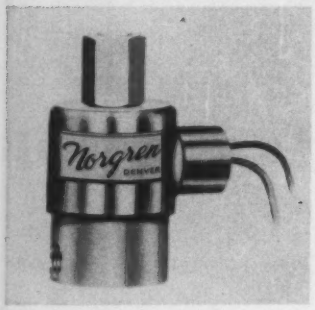


Variable Speed Control

Item 420

A micrometer dial on the control unit permits speed settings to one part in four thousand. All speeds from any desired maximum to zero and reverse are provided, with speed adjustable whether the transmission is running or stationary. In the illustration shown, the transmission is without a motor, but it is available with a built-in motor and a variety of built-in reductions including single and two-stage in-line types and right-angle worm gear types with output shaft horizontal or vertical, up or down. Transmission is self-lubricated, has inherent overload protection which prevents damage to the transmission or to the driven machine in the event of jam or overload. Sizes range from 1/8 through 3 hp. **Graham Transmissions Inc.**, Menomonee Falls, Wis.

Circle 420 on Page 129

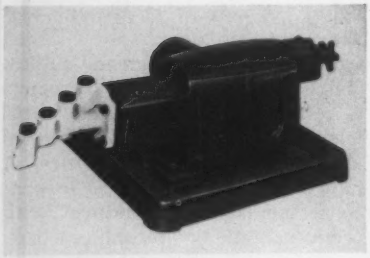


Solenoid Valve

Item 421

Line of 2-way, 3-way, and directional solenoid valves is available in 1/8 and 1/4-inch pipe sizes in both normally closed and normally open types. Valve is suitable for use with air, oils, cold and hot water, and gases. It can operate up to 600 cycles per minute at temperatures ranging from −20 to 200 F ambient and −20 to 175 F media. The plunger springs are made of stainless steel and the tube assembly is of copper, hydrogen brazed for leakproof operation. Valve has two 1/4-inch mounting holes in the base of the body, will operate in any position. **C. A. Norgren Co.**, 3400 S. Elati St., Englewood, Colo.

Circle 421 on Page 129

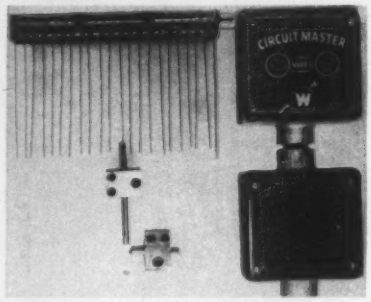


Controlled Volume Pump

Item 422

Controlled volume pump is designed for the chemical processing industry. It features a minimum of working parts and bearing surfaces to translate high speed rotary motion to low speed reciprocating motion. The speed reducer is an integral part of the pump and runs in an oil bath. This combined drive unit and speed reducer permits automatic adjustment of capacity from zero to 100 per cent. The capacity adjustment closely approximates a linear relationship and can be made while the pump is running. Several pumps can be coupled to a single speed motor, but each pump will have its individual capacity adjustment. The plunger of the pump always returns to the same forward position on each stroke to ensure maximum displacement efficiency regardless of stroke length. Units have repeatable accuracies within ±1 per cent, maximum capacities to 29 gph. They will meter against pressure to 1900 psi. **Milton Roy Co.**, 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Circle 422 on Page 129



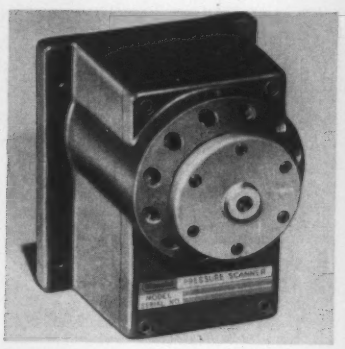
Press Overload Detector

Item 423

Electronic control is designed for power presses, will automatically shut down the press and disengage the clutch if stamped parts fail to eject. Unit includes an electronic control center, a mechanical sensing unit, circuit connection box, and a compensator unit which requires no adjustment but automatically adjusts itself to temperature changes and voltage fluctuation as well as mechanical changes that occur while the machine is in operation.

On first contact with an overload caused by pile-up, sudden thickness variation, jam, improper feeding, or other malfunction, the sensing unit relays an impulse to the electronic control unit which activates the clutch solenoid. This stops the press immediately before the die can strike again. The control can be adapted to any press equipment where the closed position of the dies are fixed or of consistent shut height. Counters can also be added to the control to count only the actual number of parts made. **Wintriss Inc.**, 20 Vandam St., New York 13, N. Y.

Circle 423 on Page 129

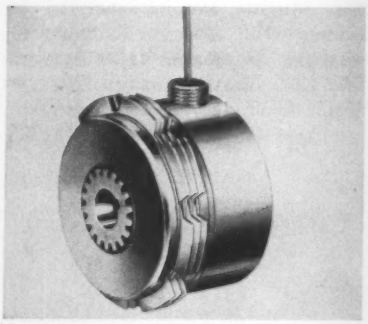


Pressure Scanner

Item 424

Using only one transducer, scanner is capable of measuring a multitude of pressures. Operational range for Model SP-101B is from zero to 350 psig for dry air and noncorrosive dry gases. Principle of the scanner is to vent the transducer to atmosphere between successive ports, thereby reducing hysteresis effects. Unit features a low internal volume and it can be externally programmed to switch pressures in any sequence desired. **Datex Corp.**, 1307 S. Myrtle Ave., Monrovia, Calif.

Circle 424 on Page 129

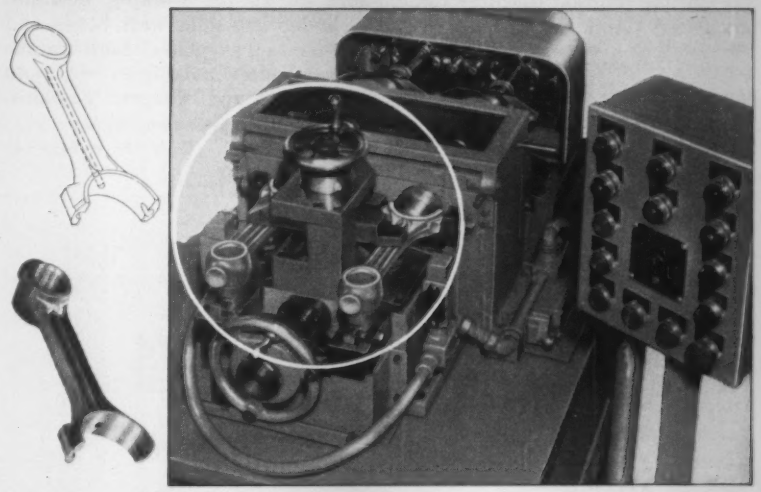


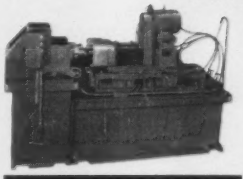
Electric Clutch

Item 425

Unit features a stationary coil, is available in a range of sizes from ¾ inch bore to 3½ inch bore and up to 2400 lb-ft of torque (static). A disc assembly is combined with an electromagnetic operating mechanism. With this design, the clutch is held in engaged position by the action of magnetic flux passing through buttress plate, disc assembly, and end plate. Upon release, the disc separator separates the discs individually and breaks up residual magnetism, providing a

standard gun drilling machine





- **Assures Concentricity, Size and Finish**
- **Handles An Endless Variety of Parts**
- **Eliminates Secondary Reaming Operations**

amazingly versatile

This Standard Machine can be adapted for various depths, and for various size holes, with the smallest amount of fixturing. Concentricity, size, and quality of finish is no longer a problem in any hole—deep or shallow.

completely automatic

Except for load and unload, the entire operation of this New Gun or Deep Hole Drilling Machine, is completely automatic. Automatic load and unload can be provided as an extra feature, if so desired.

torque drive adapter

A Torque Drive Adapter, with contact switch, protects the cutting tools from breakage. If dull drills, or improper grinding, cause excessive torque, feed and rotation of the spindle stops, and it returns to the back position.

coolant under pressure

During the entire operation, clean, filtered cutting oil is delivered to the end of each rotating spindle, under pressures from 75 psi to 1500 psi.

standard specifications

Available speeds 2000 to 8000 rpm. Gun drill diameters .187 to .750. Feed rate .0001 to .010 per/revol. Feed stroke 1.00" to 12.00". Maximum stroke of 20" for tool changes. For longer strokes and for larger drill sizes, other models are available.

For Complete Details Call or Write

CRESCENT

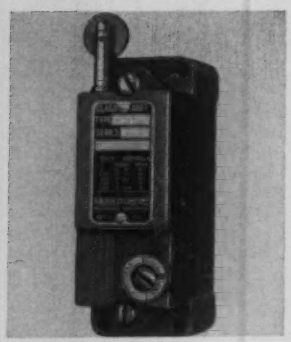
TOOL & MACHINE COMPANY, INC.

25125 West Outer Drive • Melvindale, Michigan

Circle 676 on Page 129

positive floating neutral. The only frictional contacts between moving and stationary units are those with the coil housing bearings. In the event of current failure or safety device cut-out, the clutch will disengage. Clutch will operate at 90 v dc. **Carlyle Johnson Machine Co.**, Manchester, Conn.

Circle 425 on Page 129

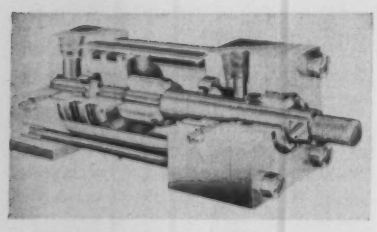


Plug-In Switch

Item 426

Oiltight limit switch features a roller plunger operator designed for cam actuation with a micrometer adjustment which permits up to ⅛-inch movement of roller position after the switch has been installed. If the switch setting must be changed, the knurled adjusting knob can be marked to assure exact repositioning. Switch can be mounted in six different arrangements and roller operating direction can be changed 90 degrees to allow for a cam approach perpendicular to the base of the switch. Units are available for 110, 220, 440, and 600 v service. **Square D Co.**, 4041 N. Richards St., Milwaukee 12, Wis.

Circle 426 on Page 129

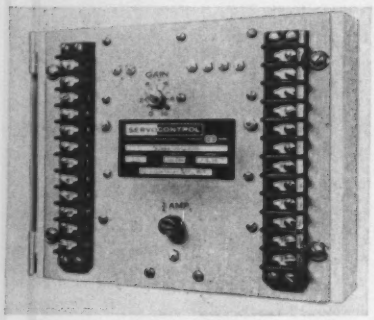


Square Head Cylinder

Item 427

Features of the square head cylinder include: A super-cushion for air and a master self-aligning oil cushion. It is available in nine bore diameters ranging from 1½ to 8 inches; will operate on air up to 200 psi or oil up to 500 psi. Designed to produce maximum force with minimum pressures, it is also adaptable to the use of low pressure oil as the working medium. Cylinder has solid steel heads and mounting plates, hard-chrome plated bodies and piston rods, and a metallic rod scraper. **Tomkins-Johnson Co.**, Jackson, Mich.

Circle 427 on Page 129

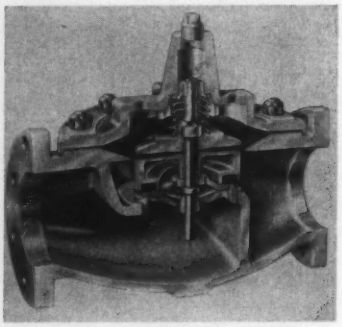


Power Amplifier

Item 428

Designed to operate company's electrohydraulic servo control system, power amplifier is capable of receiving one or more low power ac input signals and amplifying the resultant output to power level capable of driving wound ac servomotors and dc torque motors rated up to 5 w output. A diode clipping circuit protects the amplifier against input voltage as high as 55 v. The basic circuitry consists of a low power level push-pull input stage driving an output stage which operates in a push-pull fashion through a special circuit arrangement. Two transistors per stage are used to increase reliability. The amplifier input circuitry has a flexibility which permits a choice of ratio comparison, parallel summation, or series summation of input signals. Model SC-AU20-001 is mounted on a hinged bracket for ready access to the rear of the panel. The amplifier panel can be removed from the bracket and rack mounted. Input power of the unit is 25 w, 115 v (−15 per cent), 60 cps. **Oilgear Co.**, 1571A W. Pierce St., Milwaukee 4, Wis.

Circle 428 on Page 129

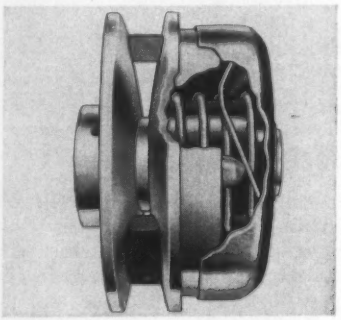


Hydraulic Valve

Item 429

Device features a heat resistant diaphragm material, is suitable for use in continuous service at temperatures up to 250 F. It is applicable in filters, boiler-feed units, and waste-water disposal systems. Valve has a backless design. The valve disc that opens and closes the valve is an integral part of the diaphragm assembly. The unit is closed by hydraulic pressure applied to the valve cover through a small control tube. It is opened by releasing the pressure, allowing the line pressure to lift open the diaphragm and disc. Three-way pilot valves are used to apply or release the pressure in the control tube. Valve is available in sizes ranging from ½-inch to 16 inches, with screwed or flanged connections. **Automatic Valve Systems Co.**, 1535 Monrovia Ave., Newport Beach, Calif.

Circle 429 on Page 129



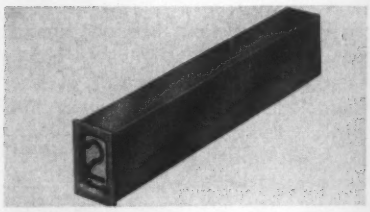
Variable Speed Pulley

Item 430

Variations in load do not affect speed of unit because of a cam which automatically maintains required belt tension for a given load. This cam prevents the pulley faces from spreading and holds the pitch

diameter at the desired setting. The contact springs maintain initial tension and prevent the belts from being placed under excessive pressure. Pulley is available with speed ratios from 2 to 1 for ½ and ¾ hp at 1750 rpm, or a speed ratio from 2½ to 1 for a 1 hp model. **Lovejoy Flexible Coupling Co.**, 4884-H W. Lake St., Chicago 44, Ill.

Circle 430 on Page 129



Digital Indicator

Item 431

Readout has one-inch characters, operates on a direct drive basis. Numbers zero through 9 and two blanks are displayed in sequence, in response to four-bit binary coded decimal input. Indicator uses major portion of its frontal area for display. Indicator is mounted in a gasket sealed case to prevent dust or moisture from hindering operation. It is rated for 24-28 v dc. Life expectancy is 1,000,000 operations. **Union Switch & Signal, Div., Westinghouse Air Brake Co.**, Pittsburgh 18, Pa.

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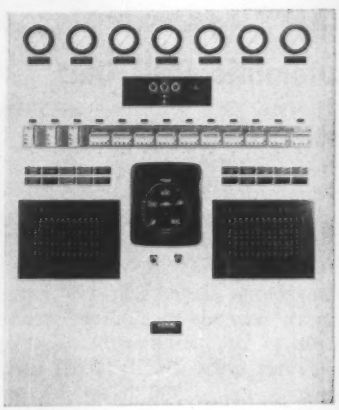

Alarm Scanner

Item 432

Unit is capable of automatically scanning any number of measurements in rapid sequence. It is applicable for industrial furnace temperatures, bearing temperatures in powerplants, and compressor stations for cooling water, cylinder head and lube oil temperatures, and compressor rpm. Several hundred points can be scanned with one unit. The scanning rate can be set at 1, 3, or 5 points per second. Features of the unit include: Visible and audible alarm, repeatability of alarm settings ±0.05 mv, and a heavy duty pinboard with self cleaning pins.

In scanning a measurement point, the output voltage of a thermocouple or other measuring element is compared with a reference voltage which has been preset on the pinboard to correspond to the high or low temperature for which a warning is desired. If the resulting comparison voltage reflects an alarm condition, it will actuate the alarm unit to give visible and audible warning to the operator. **Foxboro Co.**, Foxboro, Mass.

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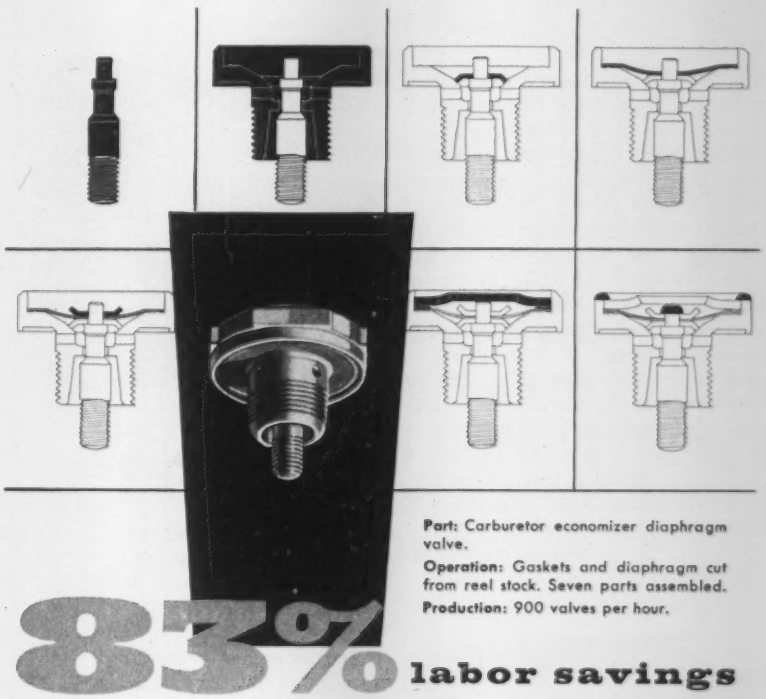

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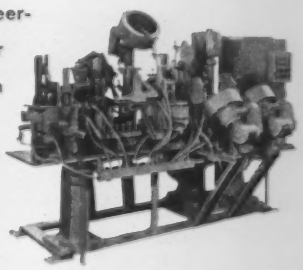

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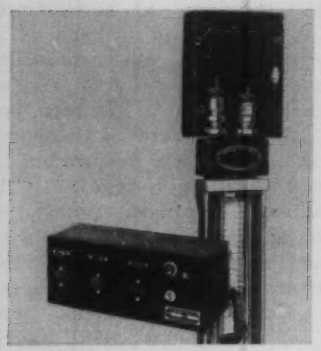

Pressure Switch

Item 433

Device is applicable for controlling pressure, vacuum, differential pressure, flow, and liquid level. Switch consists of a contactor manometer and a relay-power-supply package. The use of a special indicating fluid gives a make-or-break control sensitivity of 0.005 in. of water. It can sense pressure increments as small as 0.003 oz per sq in. Unit has a modular construction and uses interchangeable plug-in circuit cards. It is available in two types: A plug-in model for temporary connections and a tamper-proof model for permanent monitoring. Switch is rated for 115 v ac, 5 amp. **Meriam Instrument Co.**, 10820 Madison Ave., Cleveland 2, Ohio.

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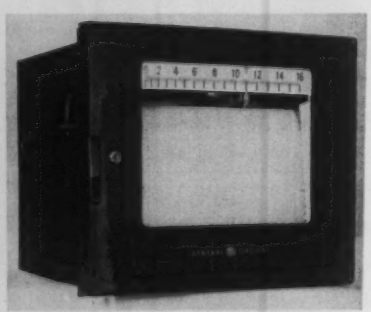

Strip Chart Controller

Item 434

Instrument can be used to measure and record watts, vars, power factor, frequency, temperature, flow, and pressure. The null-balance strip chart recorder-controller is available in a dc potentiometer, ac or dc bridge version, and both single-pen and multirecord types. Printed circuits and plug-in components are used throughout the instrument. Components are isolated by function and wiring mazes are eliminated. Unit has a 10¾-inch calibrated chart width. A silicon diode reference provides continuous automatic standardization which gives continuous measurement and control. All major components are mounted on the rear of the mechanism panel. The panel swings out through a 160 degree arc for convenient servicing. **General Electric Co.**, Schenectady 5, N. Y.

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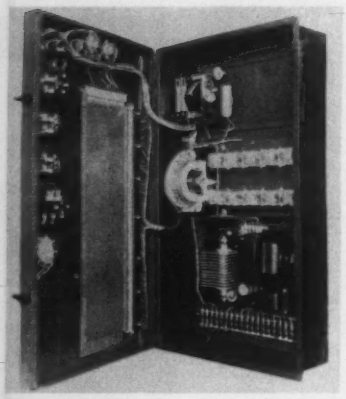

Patchboard Programmer

Item 435

Designed to actuate company's multiple circuit programmer, patchboard operates by sequential switching of a plurality of load. The patchboard can be inserted for permanent or temporary programming. Unit operates on a pulse generation from an external push-button, internal time base, or limit switch. The desired program is set up by plugging telephone switchboard type cords into diodes on the patchboard. Speeds as fast as 30 steps per second can be used. **Automatic Timing & Controls Inc.**, Dept. 208, King of Prussia, Pa.

Circle 435 on Page 129

Flow Control Valve

Item 436

Device is available in sizes ranging from ¼ inch through ¾ inch. Features of the valve include locked screw adjustment, threaded stem, and molded nylon flapper. The lower range of flow rates is metered by adjusting the position of the ground cylindrical stem within a concentric bore in the valve body. As the regulating portion of the stem clears the bore, the stem end contacts the flapper, lifting it off its seat. The flow is then controlled by the clearance between the flapper and seat. On return, the flapper lifts clear, providing unrestricted passage of the controlled medium. Flow rate adjustment is retained by an external lock nut on the slotted adjusting stem. **Valvair Corp.**, 454 Morgan Ave., Akron, Ohio.

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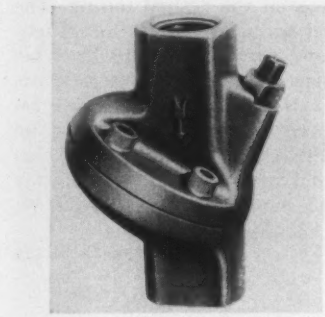

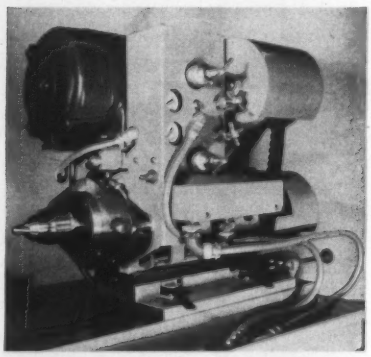

Automatic Drill Unit

Item 437

Model 505 is adaptable for single point tool hollow milling, endforming, pointing, and chamfering, as well as drilling and tapping. Speed range of the unit is from 600 to 12,000 rpm with a single speed 1725 rpm motor. Chuck capacity range is from zero up to ½-inch; strokes are up to 1½ inches with repeat on hole depth within ±0.002-inch; thrust is up to 980 lb at 100 psi maximum air pressure.

Some of the features of the drill are: Stepless speed adjustment over the full speed range, pressure regulators with extremely fine infeed and retract speed controls, and a front quill bearing that is adjust-

able to take up all excess looseness. Optional equipment available is a woodpecker attachment which provides interrupted tool infeed to withdraw chips and cool the tool when drilling deep holes, and a broken tool detector which stops the drill unit in the event of drill or tap breakage. **Batchelder Engineering Co. Inc.**, 125 Main St., Springfield, Vt.

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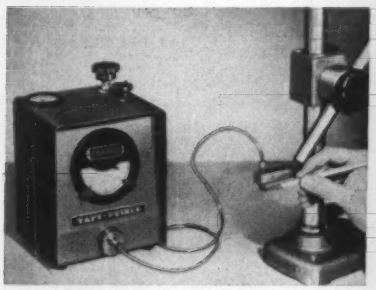

Air Gaging Capsule

Item 438

Suitable for on-machine inspection jobs, capsule can be used with company's air gages to provide a fast visual readout with quick response. The capsule is a small pick-up of the direct contact type. It is equipped with carbide contact points, 3-foot air hoses, and can be supplied permanently mounted in 90-degree adapters. The capsule is also available in a long-range model designed for wide tolerance gaging, with a range of 0.004 to 0.040 inch. **Taft-Peirce Mfg. Co.**, Woonsocket, R. I.

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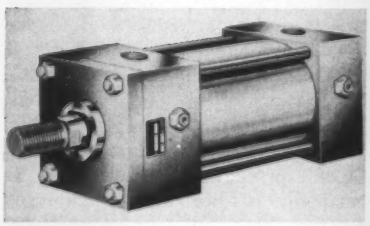
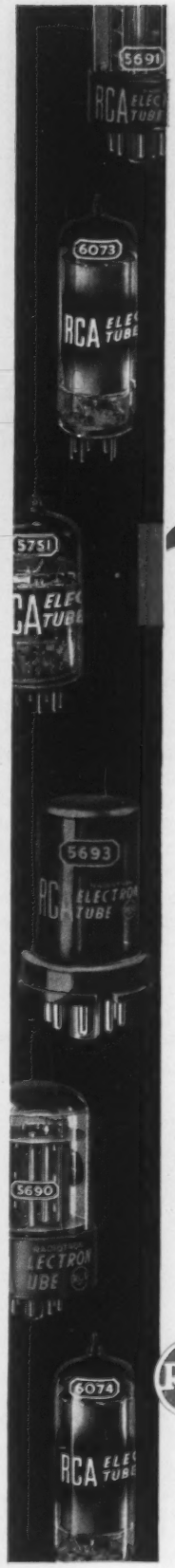


Air/Hydraulic Cylinder

Item 439

Components for 21 mounting styles are available to provide numerous combinations for various applications. Cylinder is adaptable for air, oil, or water service, can operate at pressures up to 200 psi,



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Handy data book RIT-104-A includes the tube characteristics you need to know when you install RCA "Premium" and "Special Red" Tubes. Free, from your RCA Industrial Tube Distributor.

air and 500 psi, oil or water. Unit features rustproof ferrous parts, hard-chrome plated piston rods, and micro-honed brass barrels. Block-vee piston seals and removable cartridge-retained rod seals are designed for operation at temperatures from −20 to 150 F. For use at higher or lower temperatures, special seals can be furnished. **S-P Mfg. Corp.**, 30201 Aurora Rd., Solon, Ohio.

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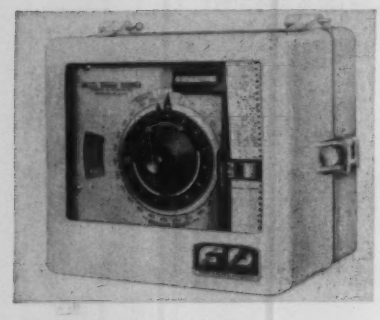


Digital Recorder

Item 440

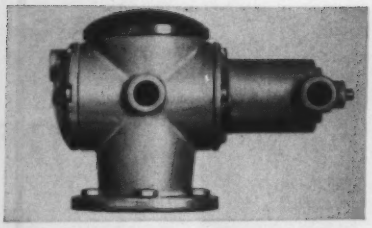
Suitable for production and data handling operations, instrument can count the number of units produced during any preselected time interval. It is operated by electrical impulses from a contact device and produces a permanent record on punched paper tape. The tape record can be visually interpreted or it can be used with automatic data processing machines. Periods of peak production efficiency and of unproductive or machine downtime can be determined. A cumulative production total can also be presented. Recorder is available with time intervals of 5, 15, 30, or 60 minutes. **Fischer & Porter Co.**, 935 Jacksonville Rd., Hatboro, Pa.

Circle 440 on Page 129

Valve Positioner

Item 441

Suitable for use on cylinder and diaphragm type actuators, positioner is furnished in four different models to provide an infinite number of stroke lengths up to 8 inches in any combination of control forms. Linearity is said to be better than 1 per cent regardless of stroke length. Model J responds to signal changes as low as 0.001 psi



and is unaffected by vibration. Increasing or decreasing outputs can be applied to either the top or bottom of an actuator in a single mounting of the positioner.

Unit operates on the force-balance principle. Position feedback is accomplished by a tension spring connected to the top of the piston of a cylinder actuator or the diaphragm of a diaphragm motor. An increase in instrument air pressure forces the yoke assembly from left to right, causing the pilot ball to restrict an opening, building up pressure in the pilot chamber. The pilot diaphragm is moved to the right, closing the relief port and opening the supply valve. Air flows into the chamber above the piston which, when moving downward, stretches the range spring. This causes the bellcrank to pivot counterclockwise, exerting force against the yoke pin to restore the yoke and pilot assembly to a normal balanced condition. A decrease in instrument air pressure reverses the procedure, closing the supply valve, and opening the relief port, venting the actuator pressure to atmosphere. **Conoflow Corp.**, Dept. D-5, 2100 Arch St., Philadelphia 3, Pa.

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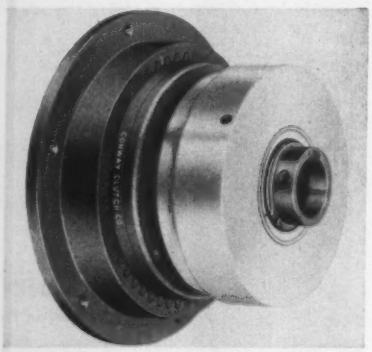

Air-Operated Clutch

Item 442

Stationary air housing, complete interchangeability with mechanical clutches, and adaptability to coupling mounting are some of the features of air-operated clutch, designated Stationaire. Unit has one basic drive for 6 different applications which are: Outflange adapter, inflange adapter, ball-bearing sleeve, bronze-bushed sleeve, bronze-bushed sleeve coupling, and ball-bearing coupling. Clutch can be mounted anywhere along the shaft and can be used as a double-throw clutch. **Conway Clutch Co.**, 1105 Marshall Ave., Cincinnati 25, Ohio.

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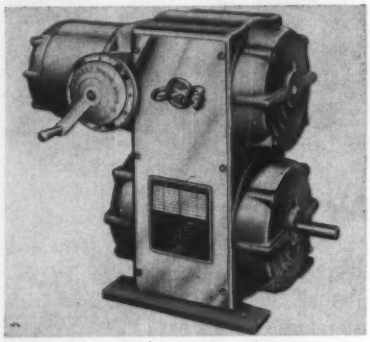

Adjustable Speed Drive

Item 443

Drive has an infinitely adjustable speed over ranges up to 8:1, is applicable in chemical processing, machine tool, metalworking, and woodworking operations. Drive operates from an ac power source, is available in ratings from 1 to 20 hp with output speeds of 1 to 10,000 rpm. A squirrel cage induction motor provides adjustable speed through the mechanical interaction of adjustable diameter discs and a ribbed belt. Internal design of the drive distributes belt tension equally between four ball bearings for maximum bearing life.

Constructed on the "building block" principle, the unit can be vertically or horizontally mounted on the floor, wall, or ceiling. Location of the output shaft and motor can be in four positions and the location of the speed changing mechanism can be on top, right, or left of the motor housing. **Louis Allis Co.**, Dept. P, 427 E. Stewart St., Milwaukee 1, Wis.

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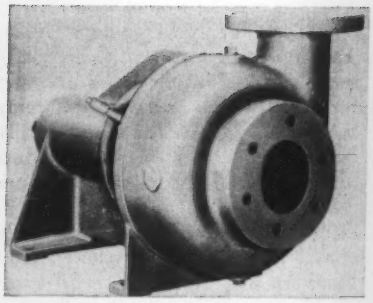

Non-Clogging Pump

Item 444

Equipment is furnished in two models. Type D is suitable for general duty pumping of solids at high heads and high capacities. It is available in 4 and 6 inch sizes. Type DL (shown) is a smaller pump (available in a 4-inch size), suitable on low head applications. Both models can be furnished with a variety of drives which include: Belt, close coupled, pedestal mounted, and extended shaft.

Pump features a recessed impeller for free flow of material through the pump, minimizing damage to delicate particles and allowing the pumping of pulps with a high solids content. Since there is a minimum contact of the impeller with material being pumped, pump wear is reduced. **Pump Div., Western Machinery Co.**, 650 Fifth St., San Francisco 7, Calif.

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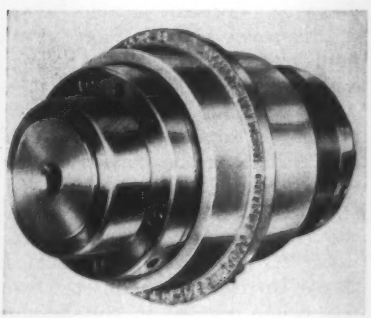
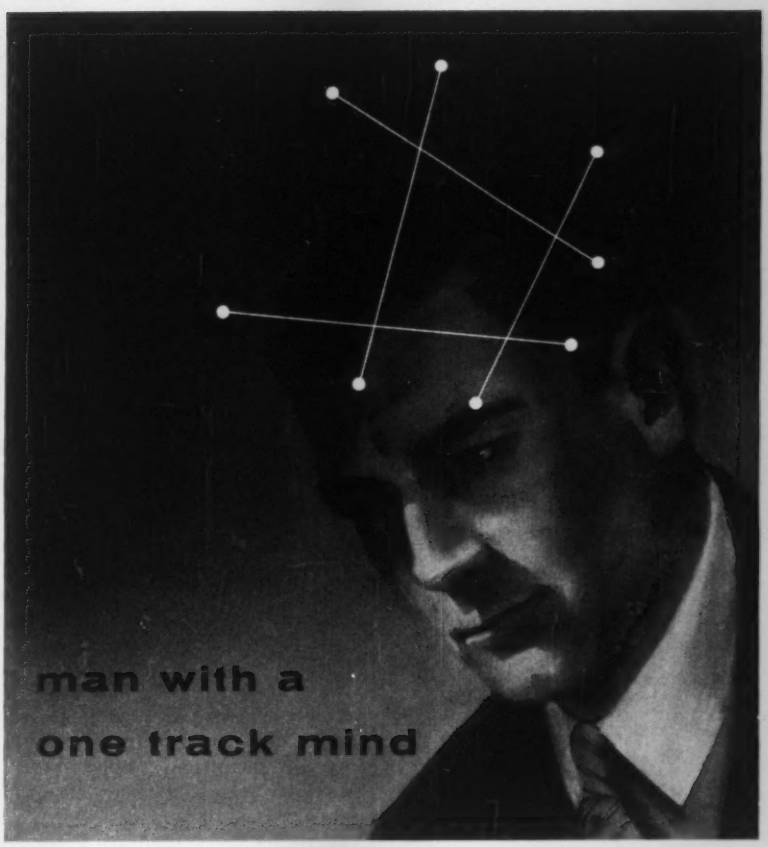


Cut-Out Coupling

Item 445

Unit features overload protection, increased misalignment capacity, and simple maintenance. Whenever there is danger of an overload, power is shut off instantly. The increased misalignment capacity provides for slight parallel misalignment, angular misalignment,



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Circle 678 on Page 129

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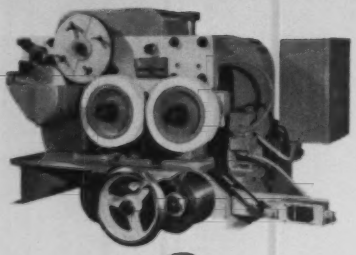

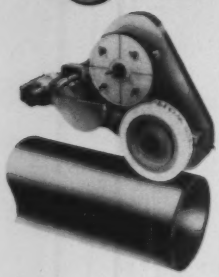

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Circle 679 on Page 129

or a combination of both. The coupling works regardless of direction of rotation. Design of the unit requires only the sleeve to be removed for maintenance purposes. **John Waldron Corp.**, New Brunswick, N. J.

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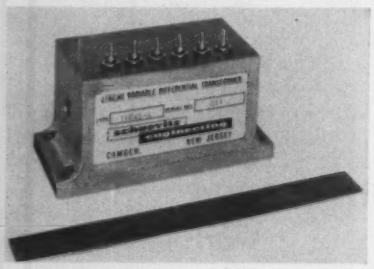

Differential Transformer

Item 446

Linear variable differential transformer is designed for heavy industrial use, such as on machinery drives where ruggedness and resistance to oil immersion are important factors. Unit consists of a shielded transformer potted in an anodized aluminum case with four mounting holes in integral flanges. Space is provided in the case for housing additional components such as temperature-compensating networks, and phase-shifting networks. Input and output connections are screw type terminals. **Schaevitz Engineering**, Route 130 & Schaevitz Blvd., Pennsauken, N. J.

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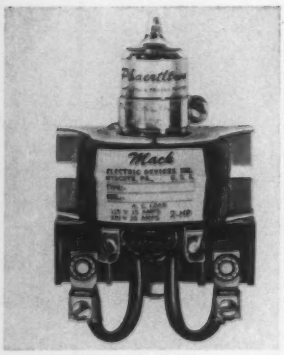
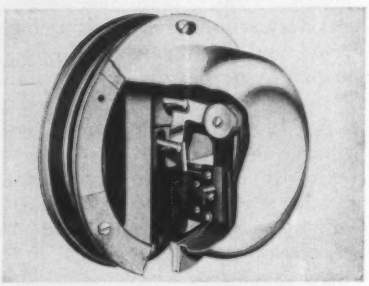


Mercury Relay

Item 447

The use of a Teflon plunger-bearing surface is said to provide a more silent operation, and a longer operating life for mercury relay. The plunger unit is hermetically sealed in heavy glass and there is no exposed arc. Tube of the relay is interchangeable and can easily be replaced if broken. Relay is dust and moistureproof; has heavy tungsten contacts. It is available in either normally open or normally closed types. Relay can take motor loads up to 2 hp and current loads of 35 amps at 110 v or 25 amps at 220 v ac. **Mack Electric Devices Inc.**, Box 98-R, Wyncote, Pa.

Circle 447 on Page 129



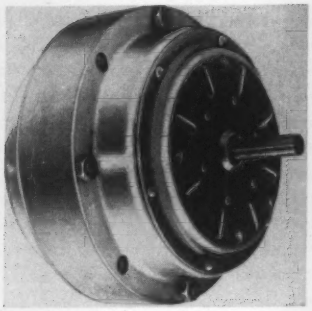
Level Gage & Control

Item 448

A feature of the automatic bin level indicator and control unit is the twist lock cover. It has no nuts or bolts and can be conveniently installed in hard-to-get-at locations. Slotted hex head screws are used and when they are loosened the cover can be turned and lifted. The indicator and control device is a diaphragm-operated switch which can be used for operation on all bulk materials that flow through a bin, hopper, or chute.

In operation, a flexible diaphragm is exposed to the material in the bin. As the material builds up to the unit, pressure of the material forces the diaphragm against the counterweighted lever mechanism. As the lever mechanism is tipped in response to this pressure, the switch located in the housing is actuated, and automatically controls signal lights, bells, conveyors, or feeding machinery. Another feature of the unit is the vented housing. As the diaphragm is flexed in response to the pressure of the material in the bin, the vent relieves any pressure build-up in the housing. **Bin-Dicator Co.**, 12813946 Kercheval Ave., Detroit 15, Mich.

Circle 448 on Page 129

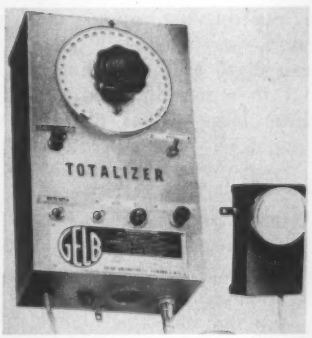


Hysteresis Motor

Item 449

Subfractional horsepower hysteresis motor features a low heat rise of 20 to 38 C (depending on horsepower rating), is applicable wherever constant synchronous speed is required. Horsepower ratings are from 1/200 to 1/20, with a running torque of 2.8 oz-in. The motor reaches full speed in 1 revolution and maintains synchronous speed at rated load. Motor is totally enclosed for protection against dirt and environmental conditions. **Dale Products Inc.**, Box 136, Columbus, Nebr.

Circle 449 on Page 129



Electronic Light Timer

Item 450

Light-activated exposure timer automatically compensates for any fluctuation in light intensities due to variations in line voltages, carbons, aging light sources, and variable light distances. The electronic eye light cell of the unit receives the light rays and transmits them to the totalizer. The light cell can be mounted on the copyboard or transparency kit of cameras, vacuum frames, or photocomposers. When the operator sets the totalizer for a 10 unit exposure, the 10 units of light will reach the sensitive material regardless of clock time or light fluctuation conditions. To synchronize the light-unit to clock-time ratio, a variable density aperture which is manually rotated, is mounted over the electronic eye window. **Jos. Gelb Co.**, Dept. K, 52 Arlington St., Newark 2, N. J.

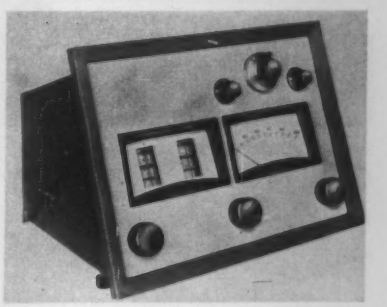
Circle 450 on Page 129

Switch Maintenance Kit

Item 451

Package contains three, two-dram bottles of lubricant for maintenance and cleaning of rotary stepping switch bank contacts and mechanisms. The bottles are packaged in a protective tray-type carton. The types of lubricant in the kit are: Blended lubricating oil, a mineral oil blended with an oil having a paraffin base; watch oil, a refined grade of fish oil, bleached, chilled, and filtered at a low temperature; and graphite-oil which consists of a blended lubricating oil and deflocculated graphite. **Automatic Electric Co.**, Northlake, Ill.

Circle 451 on Page 129



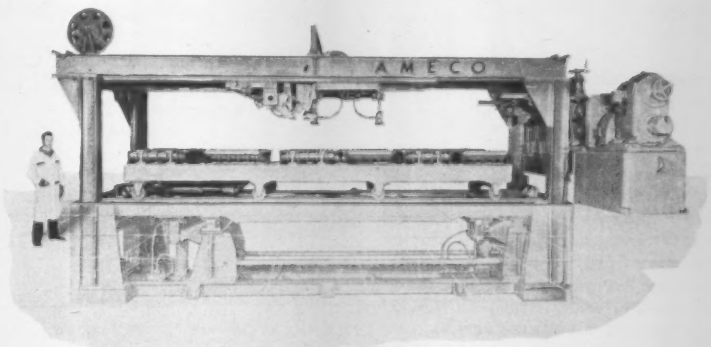
Gas Analyzer

Item 452

Self-contained instrument is capable of monitoring the purity value of gas streams. Analyzer uses a hexagonal open-core sensing cell to provide thermal dissipation. Precision machined gas trains are said to eliminate built-up tubing and fitting plumbing systems to minimize gas leaks and gas turbulence.

The power supply is transistor-regulated, gives drift-free stabilized dc for powering and sensing cell. Transistorized error amplifiers provide output voltage regulation of ± 0.25 per cent against power line variations, transient swings or load changes. Control circuits are super-

AUTOMATIC SHEET STEEL FEEDER



SPECIFICATIONS:

1—Sheet Length . . . 5′ to 20′
2—Sheet Width . . . . . 1′ to 5′
3—Sheet Gauge . . . #16 to ⅜″
4—Stack Height . . . . 0″ to 18″
5—Stack Weight . . 20,000# Max.
6—Feeding Speed 60 to 180′/Min.

FEATURES:

1—No Delay between transfer of sheets.
2—Deformed Edges rolled flat.
3—Table inches up automatically.
4—Power Rolls feed stacks from standby table

AUTOMATION MACHINES & EQUIPMENT CO., INC.
3130 WEST MILL ROAD MILWAUKEE 9, WISCONSIN

Circle 680 on Page 129

AIR-HYDRAULICS

NEW TABLE

HANDLES UP TO ONE TON

Index 30 positions per minute when equipped for 6 station operation with Air-Hydraulics' new Model 2400 (24" dia.) air index table • Handles work loads up to one ton • Bolt larger diameter plates to 1¼" ground steel table top for greater table area • Repetitive shock loads are no strain • 4" bore index cylinder develops power stroke 13 times line pressure for extra power and speed—no override • Adjustable cushion and speed control • Locking cylinder, mounted on table's centerline, means positive index every time— =.0015" • Limit switch keeps basic equipment from moving until table is "locked in" • Pressure lubrication, tapered roller bearing on shaft and ample bearing surface at circumference assure friction free operation • Operates on 60 to 175 psi line pressure • 4, 6, 8 or 12 stations with clockwise rotation standard • Others, including counterclockwise rotation, and from 3 to 60 positions to order.

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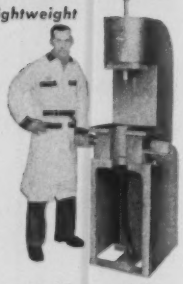
A NEW PRESS FOR LESS 15 TON—AIR HYDRAULIC

• Durable • Lightweight • Compact



Model C-500. A versatile press with 8¼ inch throat. 6 inch stroke, 2 inch adjustment, equalized pressure full length whether feather-touch or full blow. 100 pound air line gets up to 21 tons delivery. Stand or bench installation. Moving parts protected in handsome housing. Adjustable speeds. Hand, foot or automatic controls. Simple, tireless and safe operation. Women like it. Long, trouble-free service. Easy to maintain and repair. For all kinds of materials. Thickness no problem. Rivets, flanges, broaches, stakes, crimps. Many other uses.

WRITE TODAY FOR INFORMATION REGARDING APPLICATION TO YOUR JOB . . . AND HOW LITTLE IT WILL COST YOU.

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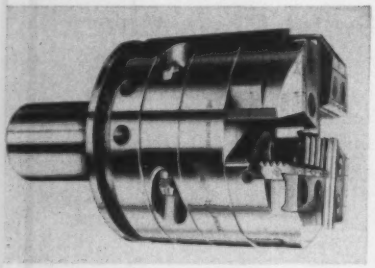
JACKSON, MICHIGAN

Circle 681 on Page 129

imposed on the nonsensing arms of Wheatstone bridge circuit with no moving contacts for smooth control and reduced background disturbance. **Industrial Instruments Engineering Corp.**, 89 Commerce Rd., Cedar Grove, Essex County, N. J.

Circle 452 on Page 129



Revolving Die Head

Item 453

Model JN is applicable to automatic screw machines and other equipment which uses a live spindle. The head body and shank are joined by two connecting pins secured by clamping screws. The floating mechanism has been eliminated to increase the life of the die head. Unit is available in four sizes—½, 13/16, 1¼, and 2 inches, with ranges varying from #4 to ½ inch to ⅜ to 2 inches. All models can be equipped with oversize chaser holders for threading above their standard range. **Landis Machine Co.**, Church & Fifth Streets, Waynesboro, Pa.

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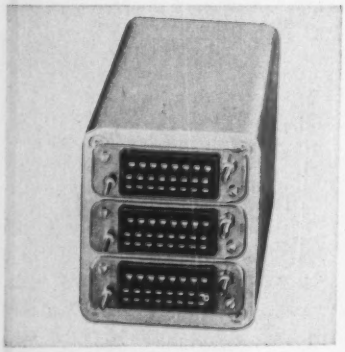

Plug-in Switch Base

Item 454

Plug-in base with removable cover is designed for Type 11 spring-driven stepping switches. The base is available with three 36-pin Amphenol plugs, three 16-pin Amphenol plugs, or two 54-pin Elco plugs. Assembly can be mounted into pigeonhole or honeycomb types of mounting racks. A hinged handle provides easy removal and inspection can be made by loosening the retaining screws that hold the cover. **C. P. Clare & Co.**, 3101 Pratt Blvd., Chicago 45, Ill.

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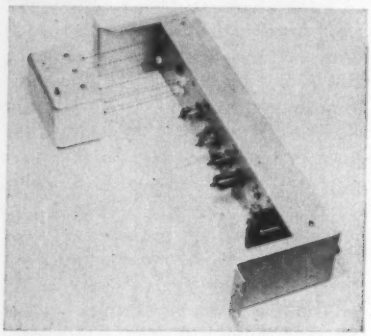

Packaged Amplifier

Item 455

Model UPA-2 is applicable in analog computing, measurement and control, continuous data reduction, and feedback operations. It can drive a 12,000 ohm load to 110 v in either direction, and will tolerate large values of cable capacitance. Typical operations that can be performed separately or in combination include: Straight amplification and inversions; slaving or transducing voltages into currents; integrating and differentiating; oscillating, clipping, multivibrating, and other nonlinear functions. Amplifier can be used as a bench-top unit, a plug-in subassembly, or it can be mounted in a rack. Four or five units can be placed side-by-side in a 17-inch chassis. **George A. Philbrick Researches Inc.**, 230 Congress St., Boston, Mass.

Circle 455 on Page 129

Digital Flow Indicator

Item 456

Applicable in production or process operations, instrument can present digital data in units of flow (gpm or lb per hr). Indicator is

based on the servo null-balance design; accuracy is ±0.10 per cent of full scale. Input to the indicator can be from any turbine type flowmeter with a maximum frequency of 500 pulses per second for full flow. Pulses from the flowmeters feed directly to a frequency converter within the indicator. Output of the frequency converter is a dc signal proportional to flowmeter output frequency. A special damped integrating input filter is included in the instrument for high-stability readings. A gravity correction control located on the front panel permits adjustment for direct readout in lb per hr. Gravity range of the instrument is 0.2 to 1.2. Indicator is rated for 115 v, 60 cps, 50 w. Converters are available for both 6 or 12 v dc operation. **Performance Measurements Co.**, 15301 W. McNichols, Detroit 35, Mich.

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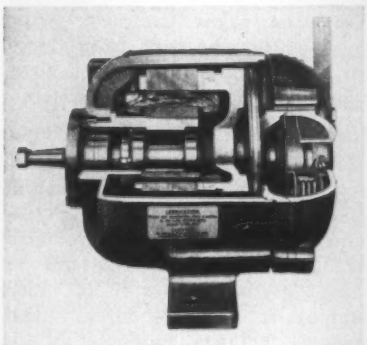

Clutch-Brake Motor

Item 457

Suitable for use on automatic production machinery, clutch-brake motor uses a constantly rotating high inertia rotor to provide stored energy for smooth fast starts under suddenly applied loads. The clutch-brake assembly, which is integral with the motor, is actuated by a lever operated by a double-acting solenoid or air or hydraulic cylinder. Upon actuation, the lever engages the clutch with the revolving rotor. Opposite actuation of the lever disengages the clutch and causes a powerful brake to stop the output shaft.

Unit is designed so the clutch-brake assembly can be removed from the housing without disconnecting the motor from its mounting. Some of the features of the motor are: External adjustments can be made without disassembling the motor; clutch and brake wear surfaces are mounted on one disc for easy replacement; and linings are either of cork or a special composition that provides high accelerating and braking torque while permitting smooth control for jogging or momentary slow speed operation. Motor is available from ½ to 5 hp. **Ferguson Machine Corp. of Indiana**, 7818 Maplewood Industrial Court, St. Louis 17, Mo.

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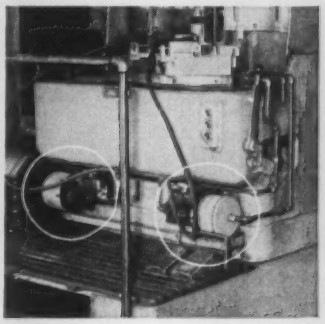
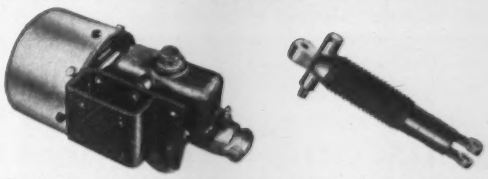
YOUR ACTUATION PROBLEM

Wagner Electric Corporation offers a wide variety of air and hydraulic actuators and controls.

For specific applications, Wagner can furnish engineered kits with actuators, controls, tubing, fittings —everything required for complete installation. Your nearby Wagner field engineer will get you detailed specifications on a system for your particular application. Call him today.





Shown above is a broaching machine with swivel type clamping fixtures, utilizing the Wagner power cluster which converts air pressure to hydraulic pressure that is delivered to actuating cylinders on each of the clamping fixtures.

Wagner Electric Corporation
6430 PLYMOUTH AVE., ST. LOUIS 14, MO. 156-2A

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ACRO WELDER MFG. CO.
MILWAUKEE
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MACHINERY BUILDERS
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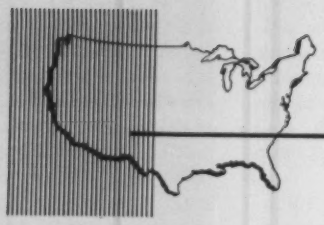
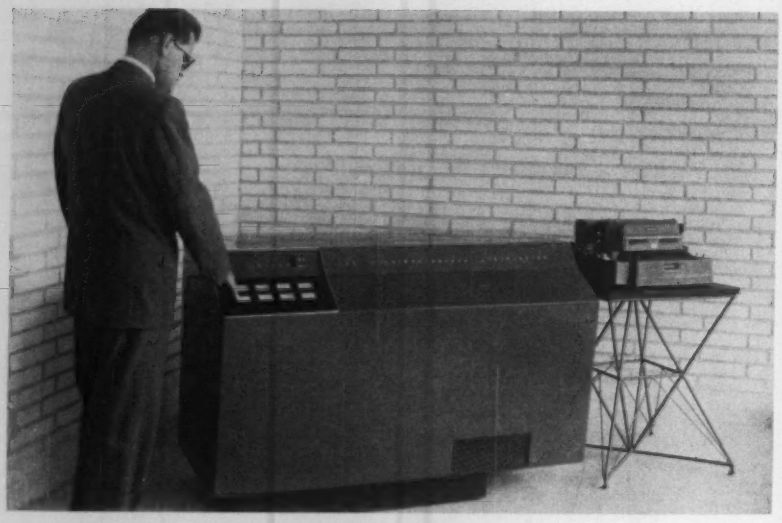
Circle 683 on Page 129



western trends

By PATT PATTERSON
Los Angeles, Calif.



Digital control computer (RW-300) manufactured by Thompson-Ramo-Wooldridge Products Co. has been purchased by Riverside Cement Co. The computer will keep track of amount, chemical composition, and point of origin of raw material destined to be blended into cement. The system will calculate type, quantity, and location of material that should be quarried to maintain optimum operations.

Weapons and Canning

THE NEW YEAR promises changes for the western aircraft and missile manufacturers. The Department of Defense has announced that a number of the new weapons systems are "ready to go," and there will probably be less stress on research and development in the weapons field.

It appears as if the firmed up plans to make a number of missiles operational will mean production contracts for west coast firms. There will be a number of changes made when such contracts are let. The difference between producing a hundred units or less and full scale production quantities is a great one to span. Some of the firms which have done a great deal of the development work on a particular weapons system may find their facilities are not adequate to turn out production.

At the same time, some firms which have had no great hand in the development of missiles may find themselves producing components, subsystems, and systems because they have the manufacturing skill, know-how, and facilities. And automation may well be the key to the production contract.

With the great amount of subcontracting on today's weapons systems, one of the biggest bugaboos in the aircraft and missile industry is interchangeability. As prime contractors subcontract the same part or assembly to two or more firms, the problem intensifies. One of the greatest hurdles is the combining of requirements for precise tolerances with requirements for interchangeability.

As aircraft, missiles and space vehicles go faster and faster, and higher and higher, the myriad components have become more and more precise. Where only a few years ago tolerances of 0.0001 inch were considered extremes, today certain components are being specified with measurements as close as 0.000001 inch. At this magnitude, it is almost impossible to have three different suppliers produce the same part within such tight limitations, and still have interchangeability of parts.

As a result, the industry is turning to automatic equipment which will produce complex parts from "masters." These masters may be special templates or models, or they may be strips of tape run through a numerical control system attached to the machine.

While numerical control of various types of production equipment is nothing revolutionary in industry, the aircraft and missile makers have put it to a new use. As a subcontract is awarded to another firm, the prime contractor often specifies that the parts be produced on a specific machine with a given type of numerical control system.

Inert Atmosphere Canning

As more and more automatic equipment is installed in industrial plants, it is apparent that the reasons for converting to automated production or processing are as varied as the type of firms which employ it. In the aircraft and missile industry automation is needed to produce precise, interchangeable parts. In the appliance field it is a necessity to achieve the high volume of production required. In the food processing industry, automated methods remove the possibility of contamination of the finished product while it is in the packing stages.

The Thornton Canning Co. of Thornton, Calif., has been one of the first to produce cold packed

food. Former methods required bringing food to sterilization, temperature, filling and sealing the hot product, and then holding at high temperature at least three minutes for sterilization of containers. Although the food was cooled as quickly as possible to room temperature, the second heating changed the flavor of the packed product.

As a result, Thornton, which packs food concentrates for the canning trade, sought a better method. The new technique involves use of a "sterile pack chamber" which uses an inert atmosphere of non-oxidizing gas. The product—tomatoes, apricots, and peaches—are packed in special 55-gallon steel drums and are shipped at normal temperatures to canning plants where they are processed for use in various food products.

Equipment was developed by Thermovac, Inc., of Stockton, Calif., and Rheem Mfg. Co. of Los Angeles. The product is heated to sterilization temperature and rapidly cooled in the sterile pack chamber. This cold sterile product is then placed into pre-sterilized containers in a special sterile chamber where sealing also takes place.

Tests of the new process have involved taking the special packs through trips across the Equator and through the Panama Canal at normal hold temperatures in a ship, with no sign of decomposition or flavor change. Some drums have been maintained at normal storage temperatures, with no additives or refrigeration used, and have been found to be perfectly preserved with no loss of palatability even after a full year.

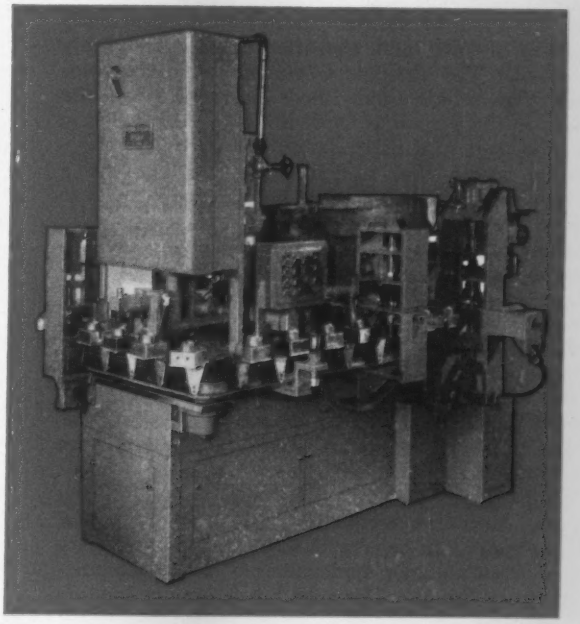
The drums used for storage are manufactured specially for the process by Rheem, and contain a special O-ring type of lid seal. A special opener is required.

The special ring sealed lids have held 27 to 28 inches of vacuum for more than a year in normal storage and transportation. Some sources claim the same method may be used with smaller containers for consumer use. If this is found practical, canners may have the answer to the flavor claims of the frozen packers, with the advantage to the consumer of no special storage facilities needed to keep the product in good condition.

ASSEMBLED IN SECONDS with a
BENERSON AUTOMATOR

No worry about clumsy hands—production slow-downs or unstable quality. Precision assembly by a Benerson AUTOMATOR is automatic! The AUTOMATOR is a pre-engineered indexing unit which provides the motivation to the automation assembly operation. Benerson Automation specialists then adapt this base unit to your specific requirements—specially engineered for the feeding, orienting, placing and ejecting assemblies.

If you assemble volume parts—today's competitive market demands a Benerson AUTOMATOR to reduce assembly costs in your plant!



FURTHER INFORMATION AND DETAILS ON REQUEST. WRITE:

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Circle 684 on Page 129

AUTOMATION abstracts

TRANSISTORS VERSUS TUBES FOR MACHINE CONTROL

By HERBERT P. GROSSIMON
Concord Control Inc.
Boston, Mass.

TRANSISTORS and vacuum tubes have the same function and operate on similar basic principles, but are physically quite different. They are made of different materials. Their manufacturing problems are different. They are affected differently by their environment. What, then, are the pros and cons of transistors and tubes in machine control applications?

The first question we should consider is this: Can transistors and tubes perform equivalent jobs in machine control? In starting a system design we must consider whether or not each is capable of meeting the system's technical specifications before making a choice on any other grounds.

Most frequently we are limited to choosing between an all transistor or all tube system. It is usually inefficient to construct a hybrid system because power supply requirements and impedance levels are so different for the two devices. A hybrid is particularly inefficient if tube and transistor circuits are richly intermixed. The exceptions, wherein the hybrid approach is useful, are usually those cases where an entire section of the system is built differently in order to take advantage of a particular tube or transistor characteristic within that section while still minimizing the number of communication links between the two types of circuits.

Variety of Circuit Applications. Tubes can perform a greater variety of technical jobs than transistors can. For one thing, there are many more different kinds of tubes available. Of particular importance to the machine-control field are the many types of thyratrons and special purpose vacuum tubes presently available. In the numerical control area, for example, multielement tubes such as the Burroughs beam tube, the gas dekatron, and the pentagrid gate tube perform data processing functions in a unique, efficient manner.

Transistors are catching up, however. Transistor tetrodes, controlled rectifiers, field effect transistors, and spacistors will no doubt soon greatly extend the field of semiconductor applications.

Frequency Range. The tube has a distinct edge on the transistor in the frequency response domain. Presently available transistors operate at frequencies as high as several hundred megacycles, but microwave vacuum triodes work quite nicely at thousands of megacycles. This advantage of the tube is of only academic interest to us, however. High frequencies are seldom used in machine-control systems, except occasionally in certain data processing circuits which may operate in the 100-kilocycle range.

Power Handling Capacity. Here again tubes and transistors are about equal in their ability to handle the requirements of most machine-control applications. Tubes offer some advantages in high power operations at frequencies above the audio range. Transistors offer some advantages in high power gain switching applications, such as in controlling solenoids from low level signals. Although presently available tubes can switch as much power as transistors, or even more, the transistor is a more efficient switch.

Input Power Requirements. Transistor circuits require less power than tube circuits because the transistor is a more efficient control device, and because no filament power is required. As an example, the total input power to a large numercial control system with 500 tubes is about 6 kw, whereas the transistorized equivalent would dissipate only about 1.5 kw.

The cost of power saved in machine-control applications, however, is trivial. The extra 4.5 kw dissipated

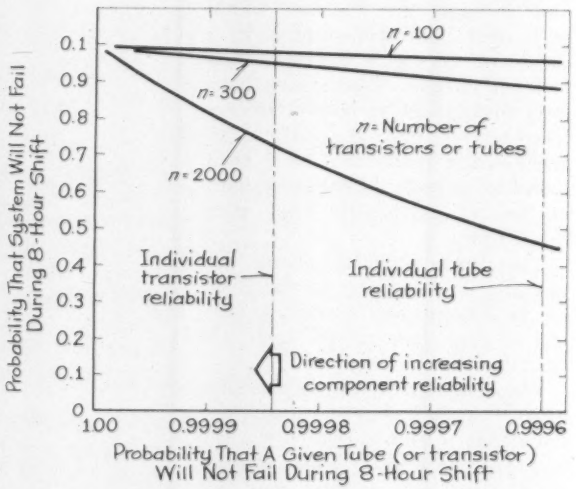


Fig. 1—Graph illustrates probabilities that system failures will not occur for systems composed of various numbers of identical components that have individual reliabilities less than unity. Greatest potential for system reliability improvement by replacing tubes with transistors exists when number of components is large, as illustrated by lowest curve for n = 2000.

in the 500-tube system would cost only about 10 cents an hour.

Temperature. In transistor systems temperature is the most important environmental consideration. Transistor characteristics are sensitive to temperature changes. Internal leakage currents increase with temperature, operating points shift, and circuit characteristics change. If proper circuit design precautions are not taken, a thermal run-away condition can begin.

The absolute maximum operating temperature for germanium transistors is about 70 C. Above this temperature, both n and p-type germanium crystals behave electrically as if they were pure germanium. The p-n junction, and hence diodes and transistors, fail to operate. Silicon devices operate satisfactorily up to about 250 C, but they are more costly.

Maximum allowable temperatures for vacuum tube envelopes are roughly about the same as maximum allowable silicon transistor temperatures. Whereas germanium transistors are satisfactory for most machine-control applications, special applications in environments which can create equipment hot spots will require either silicon transistors or tubes.

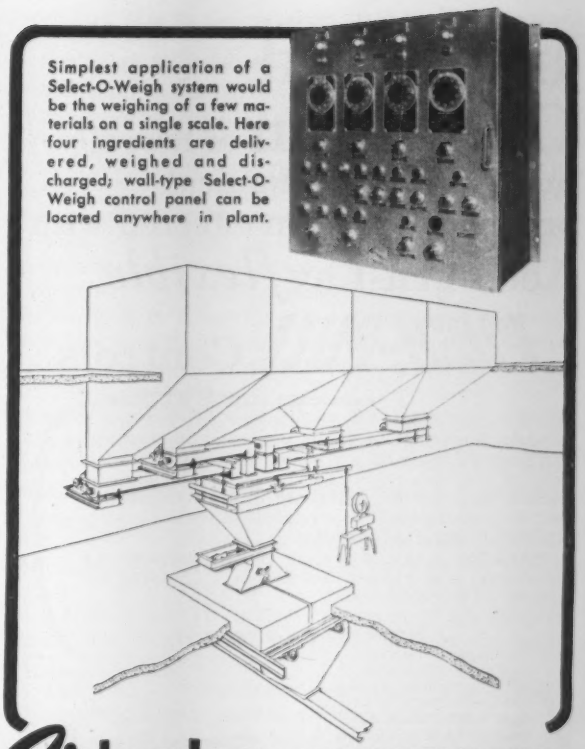
Vibration. Transistors are decidedly more rugged than tubes. Vibration of tube elements can cause amplifier distortion or even false counts in digital circuits. Severe vibration can cause interelectrode shorts and permanent damage. Where vibration is present, the transistor has an advantage over the tube.

Reliability. Certainly the greatest attraction of transistors, as far as machine control applications are concerned, is their potential for providing improved reliabilities. Two questions are important here. How does the reliability of the transistor compare with the reliability of the vacuum tube? How is the reliability of a machine control system affected by transistorizing?

There is little doubt about the answer to the first question: Transistors last longer than vacuum tubes. High quality tubes generally available for machine control have a mean life of approximately 20,000 hours. The mean life of transistors is probably at least twice as long, although accurate data are still not available. However, most authorities agree that presently available transistors, properly applied, have a life expectancy of approximately 50,000 hours.

How much, then, can the reliability of a machine control system be improved by transistorizing? The answer to this depends upon the degree to which unreliability in the equivalent vacuum tube system is caused by the tubes themselves. In tube systems where reliability is already high or where a large percentage of the unreliability is due to components other than tubes, obviously little can be gained by transistorizing. On the other hand, in systems where overall reliability is very dependent upon tube reliability, a noticeable improvement can be made by transistorizing.

One case where system reliability cannot be greatly improved by transistorizing is illustrated by the uppermost curve in *Fig.* 1. The curves show the relationship between system reliability and individual component reliability for different size systems. For simplicity, the assumption is made that the systems under con-


Simplest application of a Select-O-Weigh system would be the weighing of a few materials on a single scale. Here four ingredients are delivered, weighed and discharged; wall-type Select-O-Weigh control panel can be located anywhere in plant.

Richardson SELECT-O-WEIGH

Modern, cost-cutting system for automated processing

The Richardson Select-O-Weigh system electrically controls, in proper sequence, gates, feeders, scales, mixers, conveyors and other materials handling equipment. For proportioning of various solids and/or liquids to make up a finished product, it opens the way to new economies and increased production. The entire Select-O-Weigh system can be supervised by a single operator. No specialized training is required. Service and maintenance is fast and easy.

Many special advantages are provided by a Richardson Select-O-Weigh system. Improved product quality, uniform from batch to batch, is assured by precise weight control of all ingredients. Three types of controls allow fast formulation change, private where desired. A full line of automatic control accessories is available to tailor the system to your particular requirements.

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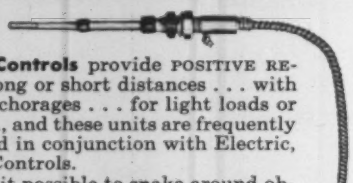
Improved Operation of literally hundreds of mechanical products has been effected with Acco Tru-Lay *flexible* PUSH-PULL Controls



Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electric, Hydraulic and Air Controls.

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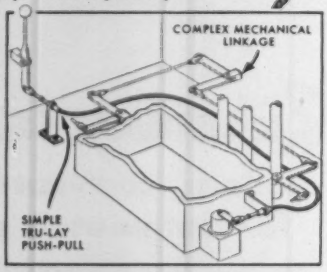

Positive Remote-Action and Flexibility, together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

Immunity to Vibration makes these TRU-LAY PUSH-PULLS ideal as Remote Controls on shakers and other vibratory products.

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SYSTEM "A"	Component group	Average No. of failures in 100 8-hour shifts	Average downtime per 100 shifts (2 hours/failure)
TUBES	Mechanical	2	4
	Electrical	2	4
	Electronic (tubes)	11	22
	Electromechanical	30	60
			90 Hours total downtime
Per cent up time = $\frac{800-90}{800}$ = 88.8%			

SYSTEM "B"	Component group	Average No. of failures in 100 8-hour shifts	Average downtime per 100 shifts (2 hours/failure)
TRANSISTORS	Mechanical	2	4
	Electrical	2	4
	Electronic (transistors)	5	10
	Electromechanical	30	60
			78 Hours total downtime
Per cent up time = $\frac{800-78}{800}$ = 90.3%			
Per cent up time if transistors absolutely trouble free = $\frac{800-68}{800}$ = 91.5%			

Fig. 2—Comparison of up times for two machine tool systems shows limited potential in substituting transistors for tubes when reliabilities of other components dominate system reliability. System A, using 300 tubes in its control, has an up time of 88.8 per cent. System B, identical except for replacement of tubes with transistors, has an up time of 90.3 per cent. Even if transistors operated perfectly at all times, up time would increase to only 91.5 per cent in this case. Assumption is made that repairs of different component group types are not made simultaneously.

sideration consist entirely of equal numbers of either tubes or transistors, that these components fail on a random basis, and that failure of any one tube or transistor will cause system failure. The probability that a tube will not fail in an 8-hour day is assumed to be 0.9996; that a transistor will not fail, 0.99984. The probability that the system will *not* fail during an 8-hour shift is plotted as a function of the probability that any given tube or transistor will *not* fail during the same shift. From *Fig.* 1 it can be seen that the probability that no failures will occur during a given day is approximately 0.96 for a 100 tube system and 0.98 for a 100 transistor system. That is, out of 100 days, the tube system can be expected to average, in the long run, 96 days of trouble-free operation, and the transistor system 98. On the additional assumption that it requires 2 hours to find and replace a bad tube or transistor, the tube system will run trouble-free 99 per cent of the time (8 hours downtime per 800 hours total), and the transistor system, 99.5 per cent of the time (4 hours downtime per 800 hours total). Both these systems are highly reliable, and the difference in downtime caused by the difference in component reliabilities is small.

The comparison data of *Fig.* 2 illustrate a different and more practical case. Here, the effect of failures of other components in a machine tool system is also considered. The assumption is made that the system's electromechanical components are relatively unreliable. The assumed average failure rate for these components in the system is 1 failure for every 26.7 hours, that is, approximately 30 failures for every 100 eight-hour shifts. The assumed reliabilities of tubes

and transistors are taken from *Fig.* 1. For n = 300, *Fig.* 1 shows that for 89 days out of 100 there will be no expected tube failures in a 300-tube system and no transistor failures in 95 out of 100 days for a 300-transistor system. With the assumption that all failures require 2 hours to detect and repair, *Fig.* 2 compares the per cent up time for the two systems. The effect of transistorizing is to increase the up time percentage from 88.8 to 90.3. In addition, it is shown that if the transistors which are assumed to replace the tubes are entirely trouble-free, the up time is raised to only 91.5 per cent. Thus, it can be seen that transistorizing will not markedly improve the reliability of a system whose unreliability is largely determined by components other than tubes. The trouble with the system of *Fig.* 2*a* is not poor tubes, but poor electromechanical components.

Transistorizing is most effective in improving system reliability in those cases where tube reliability dominates system reliability. Such a case is illustrated by the lowest curve in *Fig.* 1. A 2000-element tube system is compared to a 2000-element transistor system with the assumption that the two systems have very few other components or that the other components contribute a negligible amount of downtime. From *Fig.* 1 it can be seen that the probability of having a failure-free day is improved from 0.457 to 0.724 by transistorizing. In terms of the previous assumption that each failure requires 2 hours to repair, the corresponding change in up time would be from approximately 86 per cent in the tube system to 93 per cent in the transistor system. This is a good improvement.

It should be clear from this example why computer manufacturers are trending in the direction of transistorizing their large computers. As many as 40 to 50 thousand transistors are utilized in some of the larger computer systems. The highest possible circuit reliability is imperative if a reasonable error-free running time percentage is to be achieved.

Cost. Individually, transistors cost more than tubes. Computer quality miniature tubes average about $1; equivalent transistors average closer to $3. This higher cost is somewhat offset by savings in cooling equipment and in cabinetry, but the fact remains that transistor circuits, and hence transistor systems, cost more to build.

Design costs are also higher for transistor systems. Whereas many companies have a large backlog of experience in designing vacuum tube systems, a much smaller number have a sizeable amount of transistor experience. For those who do, transistor design costs are down; for the others the higher costs must still be reckoned with. From the control system buyer's point of view, it is easier to find a manufacturer who can build a vacuum tube system to meet his specifications than it is to find a manufacturer for the equivalent transistor system.

This is the cost picture at present, but it is definitely changing. Costs in transistor systems are coming down. Transistor design experience is spreading fast, and improved manufacturing methods are gradually re-

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ducing the cost of transistors themselves. Fifty years of manufacturing experience is the prime reason why good quality tubes are so inexpensive. In the same manner, time will help the transistor designer solve his metallurgical and production problems.

There is good reason to expect that transistor costs will eventually drop below tube costs. Presumably by that time the life expectancy of the transistor will be even greater than it is today. Then the scales will have tipped heavily in favor of the transistor.

Summary

In comparing tubes and transistors for machine-control applications the important industrial requirements of long, trouble-free life and low cost must be kept in mind. Considerations of such items as cost of input power and miniaturization are secondary.

The tube is a more versatile performer than the transistor. Many more tube types are available than transistor types. It can more easily handle special cases. In addition, its cost is low and its reliability good.

The transistor dissipates less input power than the tube. It is a more efficient power control device. Most important to the machine control field, the transistor offers a means of extending system reliability. This is particularly important as system designs must become more sophisticated in order to meet the increasing demands of control system specifications. At present the transistor system costs more, but costs are expected to come down soon.

The transistor is seriously challenging the tube in the machine control field. However, new tube systems will outnumber new transistor systems for several years yet. But, with decreasing transistor costs and increasing transistor developments, the challenger may very well become the champion.

From a paper entitled "Tubes and Transistors in Machine Control" presented at the 10th Annual Machine Tool Conference of the American Institute of Electrical Engineers, Hartford, Conn., Oct. 1958.

SELECTING LUBRICATION SYSTEMS

By ROBERT H. COTTRELL
Lubrication Engineer
Sheffield Div., Armco Steel Corp.
Kansas City, Mo.

THERE ARE unlimited opportunities in an industrial plant to improve the lubrication of machinery by the application of automatic, semiautomatic, or manually operated central lubrication systems. Several factors should be reviewed before choosing a particular system:

Complexity of Operation. The successful operation of any system depends on how simple the operational instructions are. If these instructions are complicated, the system will fail because of sheer neglect.

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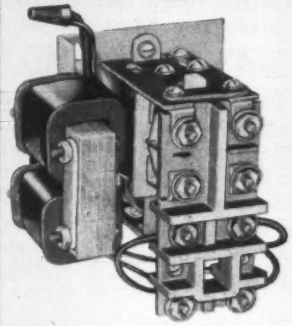

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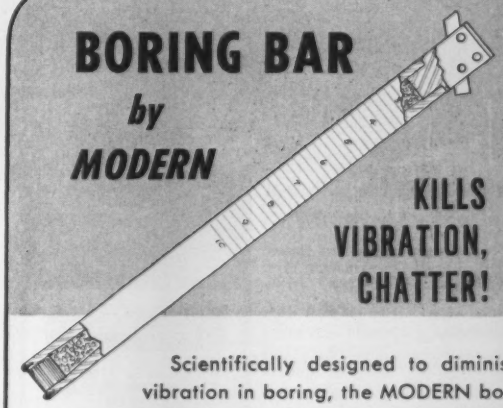

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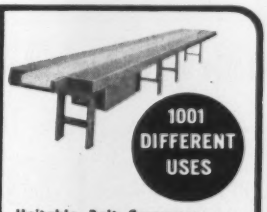

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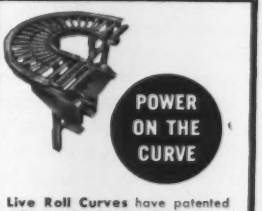

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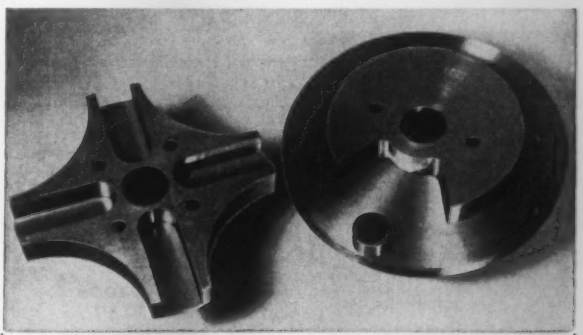

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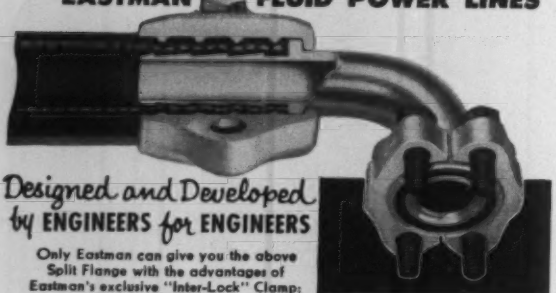

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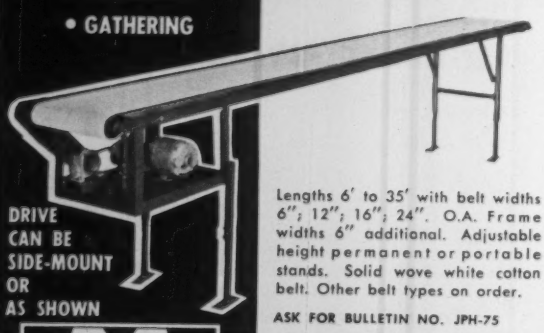

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From a paper entitled "Industry Looks At Automation In Lubrication" presented at the 13th Annual Meeting of the American Society of Lubrication Engineers, Cleveland, April 1958.

HIGH PRODUCTION AT LOW SPEEDS

By JULIAN WILLE
Consulting Engineer
Phoenix, Ariz.

AUTHOR describes machine units and systems that provide high output rates using relatively slow-speed mechanisms. Principle involves passing a chain conveyor containing spaced workholding fixtures around a circular turret. Several identical workstations equally spaced around the periphery of the turret engage the fixtures sequentially as the turret rotates. There is no relative motion between fixture and workstation during the period of engagement, therefore an operation can be performed as though both are stationary. Time available for a given workstation to perform an operation is a function of conveyor speed, turret diameter, and arc of contact of conveyor and turret.

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From a paper entitled "High-Production Automation Through Low-Speed Mechanisms" presented at the 26th Annual Meeting of the ASTE, Philadelphia, May 1958.

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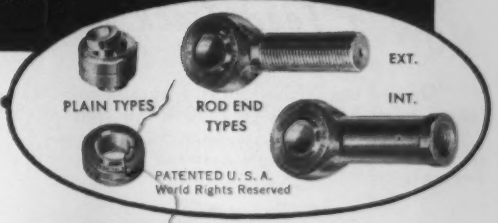

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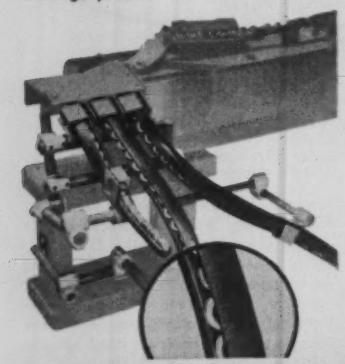

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Readers with problems concerning systems, equipment, or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solution suggestions are invited to submit them and should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

CASE 1647-P

HANDLE SHAPING

. . . We manufacture putty knives and wall scrapers for the hardware trade, and they have wood handles that rivet to a steel blade. Our problem concerns the grinding of the wood to make its contour fit the steel blade. This is now done by hand on abrasive belts and requires a certain amount of artistic skill. We can't merely rotate the blade about the centerline while holding it against the belt or the wrong shape is produced (*Desired shape is a flattened oval in cross section*). Any system of machinery would have to be designed not to scratch the blade end of the knife. We are looking for a machine that can be operated by unskilled workers, because the older experienced men are impossible to replace when they leave. Also a machine would give much more uniform results . . .

Chief Engineer

CASE 1665-P

MECHANICAL DESIGN

. . . I would appreciate any information or assistance that you can give me in regard to the mechanical design of an automatically controlled machine. Fundamentally, my problems are: 1. Calculate the inertia and friction loads involved in the precision positioning of a machine tool slide. 2. Calculate the power and drive requirements. 3. Electric drive versus a hydraulic motor drive on the above application. Thanks for your co-operation . . .

Project Engineer

CASE 1673-P

HARDNESS TESTING

. . . Although our problem is not definable only to the field of automation, we feel your magazine the proper place for presentation. We are interested in determining the hardness of heat treated hollow conical steel parts. The only method available to us at present is a destructive type of test. To permit checking a larger percentage of the parts, we must have a nondestructive type of test . . .

Supervisor, Test Laboratory

CASE 1674-P

OIL METERING

. . . I am interested in a mass flowmeter and thought you may be able to assist me in locating a firm manufacturing such an instrument. We pump various oils from our storage

(*Please turn to Page* 126)

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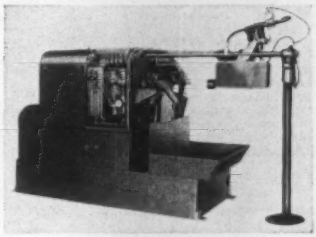

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108

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Circle 702 on Page 129

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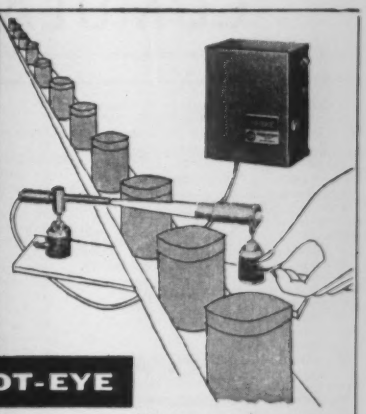

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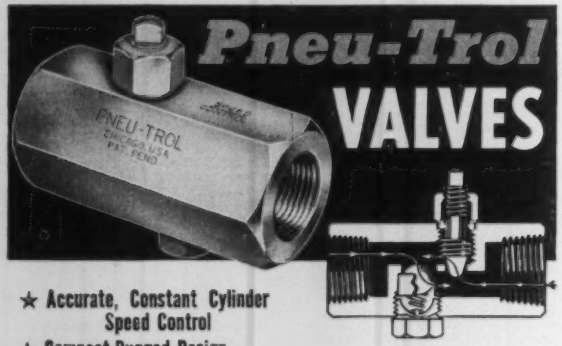
Circle 705 on Page 129

Pneu-Trol VALVES



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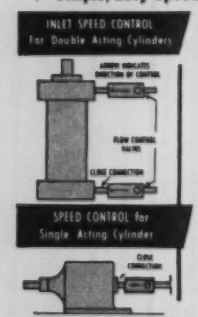

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Circle 706 on Page 129

AUTOMATION

new books

INDUSTRIAL ELECTRONICS HANDBOOK

Edited by William D. Cockrell, 1395 pages, 6 by 9 inches, published by McGraw-Hill Book Co. Inc., New York; available from AUTOMATION; $22.50 *postpaid.*

Comprehensive handbook represents the work of 102 contributing authors, and it presents in a single volume basic sections of interest with regard to industrial electronics. Following an initial section giving fundamental tables, symbols, mathematics, and physical laws are sections covering specific interests. These include control elements, power supplies, control circuits, instruments and computers, equipment mechanical design, and users' requirements. Final sections cover patent considerations and sources of technical information.

SCIENTIFIC PROGRAMMING IN BUSINESS AND INDUSTRY

By Andrew Vazsonyi, partner, Alderson Associates Inc.; 474 pages, 5¾ by 9 inches, clothbound, published by John Wiley & Sons Inc., New York; available from AUTOMATION; $13.50 *postpaid.*

The author defines scientific programming as the allocation of limited means in order to reach specific goals in the best fashion. He then discusses various theories and techniques to construct mathematical models used in scientific programming—including linear programming, theory of games, and statistical theory. Discussion covers sample business problems rather than involved mathematical proofs, and explains them in business terms.

AUTOMATIC MEASUREMENT OF QUALITY IN PROCESS PLANTS

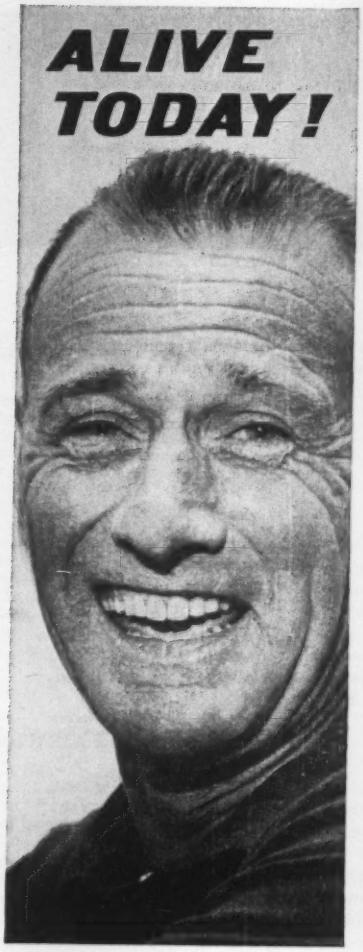
Clothbound, 320 pages, 5½ by 8½ inches, published by Academic Press Inc., New York; available from AUTOMATION; $9.50 *postpaid.*

Proceedings of a conference held at Swansea, England, by the Society of Instrument Technology. Twenty-five papers are presented on developments and applications including techniques for analysis of gas and liquid stream analysis and measurement of physical properties.

ENGINEERING FORMULAS AND TABLES

Loose-leaf, about 400 pages, 3¾ by 6¾ inches, published by Lefax, Sheridan Bldg., Philadelphia 7, Pa.; $4.75.

Pocket size reference book includes basic formulas, design data, and tables in six-ring binder. Tabbed sections cover mathematics, measures, materials, gages and screws, mechanics, electricity and magnetism, hydraulics, structural data, reinforced concrete, pipe and fittings, steam tables, and mathematical tables.



Arch Lightbody, like 800,000 other Americans, is cured of cancer. Like 800,000 other Americans he went to his doctor **in time**—in time for early diagnosis and prompt and successful treatment. He learned that many cancers are curable *if* detected in time.

You can do two things to defeat cancer: Have an annual health checkup. Be alert to the 7 danger signals that could mean cancer:

1. Unusual bleeding or discharge. 2. A lump or thickening in the breast or elsewhere. 3 A sore that does not heal. 4. Change in bowel or bladder habits. 5. Hoarseness or cough. 6. Indigestion or difficulty in swallowing. 7. Change in a wart or mole. If your signal lasts longer than two weeks, go to your doctor to learn if it means cancer.

AMERICAN CANCER SOCIETY

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confidential file

(Continued from Page 120)

tanks into a scale tank, weigh the oil, and then pump it to a designated vessel for processing. This operation constitutes a double handling of the oil which we would like to eliminate by means of a mass flowmeter. The oils vary in temperature from 40-95 F, viscosities vary from 5-4000 cps, and specific gravities vary from 0.85-1.00. The pumping rate is 50 gpm at 200 psi. We would like one instrument that could handle these different properties if possible . . .

Plant Engineering

SUGGESTIONS FOR 1571-P (AUG. 1958)

CUTTING COILED WIRE

. . . If your reader could supply us with some samples, and the following information, we could suggest some equipment to handle the job. Allowable burr? Production required? Tolerance required? Allowable distortion? . . .

A. C. Pistorius
Carl Pistorius Machine Co.

. . . We would be happy to work with this prospect. It would be necessary that they send a sample of the material to be cut and complete information as to minimum and maximum cutting lengths . . .

H. T. Randar
Artos Engineering Co.

SUGGESTIONS FOR 1607-P (SEPT. 1958)

CONVEYOR SYSTEM WIRING

. . . There are many solutions, but I believe the sketch enclosed shows the most economical. We do not show 3-phase wiring since this is quite conventional, except that provision should be included to prevent reversed rotation of motors, kicked-out by overloads, while they are still hot. The use of a single central selector switch box with only *Start* and *Stop* pushbuttons at the conveyor ends would result in the lowest equipment cost and field wiring costs. But this would not allow the end-conveyor operator to turn conveyors *On* or *Off* at will; someone at the central box would have to decide . . .

Joseph E. Van Acker
Sensory Inc.

. . . We are interested in your problem and are experienced in this type of circuit. The development of this type circuit depends on specific requirements such as; required speed of system, source of information for point of discharge, method of release to sorting conveyor, priority conditions, whether system must work full capacity or one bag in transit . . .

William Stolk
Machine Tool Electric Corp.

SUGGESTIONS FOR 1618-P (OCT. 1958)

MOLDING WAX DISCS

. . . We enclose two copies of our bulletin on Sherwood Wax Injection Presses, and recommend that your reader consider the installation of one or more for the production of the wax discs. The press could be adapted to have an extrustion nozzle so that the wax could be produced in tubes and then cut to proper thickness. Another way would be to use the automatic machine and produce individual pieces in a multiple cavity die . . .

Alexander Saunders
Alexander Saunders & Co.

. . . We manufacture wax molding equipment for 10-lb. slabs, and even though the problem you outline would be special for us, we would be very interested . . .

R. D. Watson
J. W. Greer Co.

. . . . . We have done some work with regard to molding various types of wax on an automatic basis. We are very much interested in working with your reader . . .

E. J. Fitzpatrick
F. J. Stokes Corp.

SUGGESTIONS FOR 1602-P (OCT. 1958)

LUMBER HANDLING

. . . The extreme variations in width, length, and thicknesses together with the high capacity make it a rather costly job. If these people have sufficient space, we'll be glad to study it further. If so, we should know whether it is necessary to make the 12 ft drop vertically. We should also know the speed of the boards on this conveyor. In other words, what would be the average width of the pieces when handled at the rate of 2000 per hour? . . .

W. K. Stokes
Alvey-Ferguson Co.

. . . This isn't something that we have done with lumber, but we have done it with steel and aluminum billets in the metalworking industry. You lower the boards 12 ft by declining chain conveyor operating at about 60 fpm, and then you get the 90-degree turn by using a special right curve arrangement with the roller bed operating at 700 fpm. The 90-degree turn would be made up of three 30-degree straight segments of precision rollers driven by roller chain at this high rate of speed. The inside radius would be about 20 ft and each of the three segments would have its own independent drive . . .

L. P. Robertson
Logan Co.

SUGGESTIONS FOR 1620-P (OCT. 1958)

SELECTIVE CONVEYOR CONTROL

. . . We feel we can add something to this and would be delighted to work with your reader. As you know, this is right down our "switching alley" . . .

C. A. Gunn
Kellogg Switchboard and Supply Co.

. . . In the past we have manufactured scanning systems which involved as high as 52 selective steps where we controlled and monitored temperature conditions. Since control-of-temperature problems involve switching circuits, the same engineering principle can be evolved to include a selective circuit such as is described . . .

R. A. Moenich
Tipptronic Inc.

. . . We believe the enclosed bulletin describes a machine management control system which might aid in the solution of this problem. Basically, the system selects the desired number of passes for a particular control sequence and then determines the control path for each pass in accordance with the dial information . . .

R. H. Eisengrein
Seneca Falls Machine Co.

new catalogs..... latest literature

Coiled Metal Feeding

F. J. Littell Machine Co., 4101 N. Ravenswood, Chicago 13, Ill.—110 *page catalog*—Catalog 57 is divided into eight sections. In these sections are contained data on automatic roll feeds for feeding coil stock to presses, feeding and straightening machines, units which include combination straightening machines with coil cradles or with spindle reels, and automatic centering reels for coil stock. Information is also given on cradle reels and ramps, double cone reels, and sheeting lines. Sketches show typical installation methods. Various charts list standard gage numbers for sheet steel, shearing strengths, and strengths of punch presses.

Circle 458 on Page 129

Electrical Impulse Counters

Presin Co., 2014 Broadway, Santa Monica, Calif.—28 *page catalog*—Electromagnetic impulse counters for both reading and printing are outlined. Included in the line of counting devices are: Telephone type counters with armature contacts, reading counters with reciprocating pawl actuation, and printing counters with sliding rack actuation.

Circle 459 on Page 129

Continuous Stream Analyzers

Scientific & Process Instruments Div., Beckman Instruments Inc., 2500 Fullerton Rd., Fullerton, Calif.—8 *page bulletin*—Line of process stream analyzers is described in Bulletin CL-4000. Included in the line are: Industrial pH equipment, industrial gas chromatographs, infrared analyzers, and oxygen analyzers. Schematic drawings show typical applications of instruments.

Circle 460 on Page 129

Vibrating Feeders

Arthur G. Russell Co. Inc., Forestville, Conn.—4 *page pamphlet*—Bulletin 5807 covers adjustable vibrating feeders. A variety of bowls are available for orienting parts such as headless set screws, plastic parts, metallic stampings, wire forms, and screw machine parts. The two-way feed is explained and how it can be adjusted to feed either clockwise or counterclockwise.

Circle 461 on Page 129

Variable Speed Drives

Reeves Pulley Co., Div., Reliance Electric & Engineering Co., Columbus, Ind.—8 *page bulletin*—Drives designed for sanitary-type variable speed applications such as those in the dairy, baking, food processing, or pharmaceutical industries, are described in Bulletin M-588. Also given are condensed drive specifications, assemblies, dimensions, and inspector's adjustment procedure.

Circle 462 on Page 129

Wire Stitching Equipment

Acme Steel Co., 135th St. & Perry Ave., Chicago 27, Ill.—28 *page catalog*—Line of machines for wire stitching slotted boxes, fibre drums, and telescope boxes is described. Some of the types of machines are: Side seam stitchers, top seam stitchers, and thin blade type stitchers. Two methods of wire stitching used are explained—flat wire stitching and arced wire stitching. Photos show how units are applicable for box stitching, bagging, carding, labeling, book stitching, and metal stitching.

Circle 463 on Page 129

Petroleum Products List

Sun Oil Co., Industrial Products Dept., 1608 Walnut St., Philadelphia 3, Pa.—6 *page listing*—Line of industrial products is briefly described. Products in the line include: Greases, cutting oils, hydraulic oils, quenching oils, and other metal working oils. Some facts are also given on rubber process aid, petrochemicals, spray oils, electrical oils, and textile machine oils. Order form included to obtain additional details of products listed.

Circle 464 on Page 129

Centralized Control Systems

Panellit Inc., 7401 N. Hamlin Ave., Skokie, Ill.—16 *page booklet*—"From concept to construction" is the title of Bulletin 106. It describes the design approach, materials, construction, and facilities used in manufacturing a variety of centralized control and data presentation systems. The different types of panels available are displayed, and installation photos given.

Circle 465 on Page 129

Solenoid Valves

Waterman Engineering Co., 725 Custer Ave., Evanston, Ill.—12 *page booklet*—Data are contained in Catalog 2000 on high pressure, pilot-operated solenoid valves which can control hydraulic systems. Both two-way and three-way valves in ac and dc models, with port sizes from ¼ to ¾-inch, are described. Also included is a chart which interprets JIC symbols.

Circle 466 on Page 129

Straight Side Presses

Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.—44 *page handbook*—Straight-side single and double crank presses, which range in size from 50 through 500 ton capacities, are described in Bulletin 64J. Illustrations show the various models in the line. Detailed notes on the construction of the presses are given and charts list data on punch and press speeds. Also included are short descriptions on automatic unloading, transfer, and loading equipment, and press accessories such as stroke position indicator, slide adjustment position indicator, and stroke counter.

Circle 467 on Page 129

Ram Type Turret Lathes

Machine Tool Div., Jones & Lamson Machine Co., Springfield, Vt.—8 *page bulletin*—Ram type turret lathes capable of completely automatic operation are described in Bulletin LO-5808. The lathes are equipped with Lynn hydraulic drives and have a wide selection of spindle speeds. Specifications are listed and illustrations show the operating features.

Circle 468 on Page 129

Motor Generators

Kearfott Co. Inc., 1378 Main Ave., Clifton, N. J.—2 *page pamphlet*—Technical data are listed for 60 cycle motor generators which are suitable for operation as damping tachometers, rate generators, or integrators for automatic controls. Pinion design data are also given.

Circle 469 on Page 129

Power Supplies

Lambda Electronics Corp., 11-11 131st St., College Point 56, N. Y.— 33 *page catalog*—Data are contained in Catalog 59 on line of regulated power supplies for laboratory and industrial use. Photos show the manufacturing facilities for making and testing components. Outline drawings of the power supply units are given and special features of the different models are noted.

Circle 470 on Page 129

Stainless Steel Flexible Hose

Allied Metal Hose Co., 3797 Ninth St., Long Island City 1, N. Y.—4 *page pamphlet*—Data are contained in Bulletin SSDS-562 on stainless steel flexible hose which can absorb vibration and correct for misalignment and offset motion. Bulletin reports how the hose can safely handle pressures up to 4000 psi and tem-

new catalogs..... latest literature

peratures through 1500F. Diagrams show threaded flanged end fitting connections and tables list pressure capabilities and formulae for determining best lengths.

Circle 471 on Page 129

Pneumatic Conveyor Systems

Brady Conveyors Corp., 4244 Dempster St., Skokie, Ill.—20 *page booklet*—The need for a pneumatic conveyor system in industrial and chemical plants is reported. Suction systems and how they are used inside and outside the plant are discussed. Application photos are given. Pressure systems are covered, aided by installation photos. Portable units are also described.

Circle 472 on Page 129

Control Valves

Conoflow Corp., Dept. D-6, 2100 Arch St., Philadelphia 3, Pa.— 12 *page booklet*—Construction and operating characteristics on line of Series LB control valves are described in Bulletin LB-3. Cutaway drawing shows the features of the valve and other sketches show the versatility of operation. Also mentioned are optional accessories such as bonnets for high and low temperatures, yoke-mounted pressure controller, and spring and diaphragm actuator.

Circle 473 on Page 129

Positioning Gearmotors

Jordan Co. Inc., 3235 W. Hampton Ave., Milwaukee 9, Wis.—2 *page pamphlet*—Bulletin J 200 describes a control system which can be used to directly position or to compare position with a punch card or tape command to provide a correction signal to a standard machine tool drive until position matches command. Also discussed is the application of the control components to process control systems.

Circle 474 on Page 129

Explosion-Proof Timing Units

Industrial Timer Corp., 1407 McCarter Highway, Newark 4, N. J.—8 *page bulletin*—Elapsed time, interval, time delay, and recycling timers—suitable for use in hazardous atmospheres—are described in Bulletin 800. Sketches show the various housings and a gear rack chart lists available time cycles and appropriate gear racks.

Circle 475 on Page 129

Plating & Processing Machines

Meaker Co., 1629 S. 55th Ave., Chicago 50, Ill.—4 *page pamphlet*—Data on single row plating and processing machines are contained in Bulletin U-658. An illustration of the complete machine is given and features such as the positive drive, the carriers, and the main frame are mentioned. Also listed are other machines for plating, etching, and anodizing.

Circle 476 on Page 129

Pipeline Aftercoolers

Ross Heat Exchanger Div., American-Standard, Buffalo 5, N. Y.—8 *page bulletin*—Data are contained in Bulletin 302.6K1 on line of Type A-100 pipeline aftercoolers designed for air compressors. Cutaway drawing shows construction features of the unit. Charts list specifications for the 54 available models.

Circle 477 on Page 129

Flow Meter

Fischer & Porter Co., 819 Jacksonville Rd., Hatboro, Pa.—2 *page pamphlet*—Bulletin 10A1156 contains data on a high capacity flow meter. This meter is designed to measure flow rates as high as 4360 gpm. Construction materials are listed, a chart shows capacities, and pressure and temperature curves are also given.

Circle 478 on Page 129

Automatic Turret Lathes

Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.—22 *page booklet*—Automatic chucking turret lathes are discussed in Bulletin 1179-A. The basic machine principles and machine functions which can be preset electrically are explained. A sample job record sheet is given and numerous job applications are described and illustrated.

Circle 479 on Page 129

Electronic Recorder

Hays Corp., Michigan City, Ind.—4 *page pamphlet*—Instrument, suitable for recording pressure, temperature, flow, and liquid level, is described in Bulletin 57-1190-47. Construction and design features are noted. Details are also given on two types of electronic receiver units available —slidewire and differential transformer.

Circle 480 on Page 129

Rotary Surface Grinders

Mattison Machine Works, Rockford, Ill. —2 *bulletins*—Automatic rotary surface grinders are discussed in Bulletin 245-3RM and Bulletin 147-2. Features such as magnetic chucks, wheel dressers, and the automatic sizing mechanism are explained. Photos show the different set-ups for various applications; production rates are also noted.

Circle 481 on Page 129

Overhead Handling Equipment

Cleveland Tramrail Div., Cleveland Crane & Engineering Co., 1036 E. 289th St., Wickliffe, Ohio—12 *page booklet*—Overhead materials handling equipment is outlined in Bulletin 2008N. Data on various types of carriers, cranes, tractors, track switches, and grabs are given. Installation photos are included and studies of track design, peening, and stresses are reported.

Circle 482 on Page 129

Lubricating Equipment

Oil-Rite Corp., 2318 Waldo Blvd., Manitowoc, Wis.—32 *page catalog*—Data are contained in Catalog 10 on lubricating equipment such as oil cups, oiling systems, dispensers, valves, oil gages, and chain oilers. Schematic layouts of different oiling systems are shown, and photos display different installations. For some units, installation instructions are given.

Circle 483 on Page 129

Instrument Tubing

Okonite Co., Passaic, N. J.—22 *page booklet*—Data on instrument tubing for pneumatic and hydraulic instrumentation are contained in Bulletin 1112. Construction materials and pressure tests are explained, and photos show the different types of coverings for the tubes. The types of installations are discussed, aided by sketches. Photos and instructions are given on how to make a branch connection to outer layer tubes.

Circle 484 on Page 129

Air Clamp Type Cylinder

Sheffer Corp., 326 W. Wyoming Ave., Cincinnati 15, Ohio—4 *page pamphlet*—Universal, clevis, or pivot mount air clamp type cylinders are discussed in Bulletin 458. Cylinders have 1⅛-inch bore and will operate up to 150 psi air, or 400 psi hydraulic. Sketches show construction features and accessories such as aluminum mounting brackets, steel rod eyes, and forged steel clevis and pin.

Circle 485 on Page 129

Special Automatic Machines

Automation Machines & Equipment Co. Inc., 3125 W. Mill Rd., Milwaukee 9, Wis.—4 *page pamphlet*—Notes are given on different types of machines designed to assemble a variety of component parts. Included in the line of machines are: A dual tungsten electrode gun to weld terminal clips on immersion heater elements; a machine to edge-weld seams on round, rectangular, and odd shaped tanks; and welders to join motor laminations.

Circle 486 on Page 129

Electric Strip Heaters

Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.—4 *page pamphlet* —Line of electric strip heaters can be used to keep viscous and heavy compounds moving smoothly, for ovens and special purpose air heating, and for tanks, kettles, and drums. Bulletin F-1613 contains illustrations of these applications. A chart is included which outlines the wide range

of sizes, wattages, sheaths, and special features available for 500 models of eleven basic strip heater types.

Circle 487 on Page 129

Servo Control Valves

Servocontrol, Div., Oilgear Co., 1560 *W. Pierce St., Milwaukee* 4, *Wis.*—8 *page bulletin*—Operating principle is explained in Bulletin 36100 on electrohydraulic servo valves which feature a plungerless valve design. Charts list typical flow curves, sketches show the cross-section of a valve, torque motor connections, and typical servo control systems.

Circle 488 on Page 129

Industrial Storage Racks

Chicago Tramrail Corp., 1330 *S. Kostner Ave., Chicago* 23, *Ill.*— 12 *page booklet*—Data are given in Bulletin R400 on industrial material storage racks. Styles of racks include: Drive-in models, fabricated models, suspended, and floor-type mobile models. With fabricated racks, which are engineered for individual applications, an entire system can be automated from a remote control station or from controls mounted on a trolley. Also included are two pages of installation photos.

Circle 489 on Page 129

Transformers

Chicago Standard Transformer Corp., 3501 *W. Addison St., Chicago* 18, *Ill.*—32 *page catalog*—Data on over 450 transformers are given in Catalog CT8-58. Types of units described include: Saturable transformers, hermetically sealed transformers and reactors, power circuit transformers, and step-down and isolation transformers. Performance curves for many of the units are shown.

Circle 490 on Page 129

Hydraulic Pumps & Fluid Motors

Tuthill Pump Co., 939 *E. 95th St., Chicago* 19, *Ill.*—4 *page pamphlet*—Data are contained in Catalog Section III on oil hydraulic pumps with capacities from 1.2 to 14.2 gpm, for continuous service pressures to 1500 psi, and with speeds to 3600 rpm. Spur gear hydraulic motors for continuous pressures to 1500 psi are described. Charts show typical performance curves for both pumps and motors.

Circle 491 on Page 129

Pressure Gages

Helicoid Gage Div., American Chain & Cable Co. Inc., 929 *Connecticut Ave., Bridgeport* 2, *Conn.*—36 *page catalog*—Helicoid gages, suitable for use on hydraulic presses, pumps, compressors, and blowers, are outlined in Catalog DH-65. Information on the design and operation of the gages is given and construction of the bourdon tubes is explained. Also included are dimensional drawings, specifications, and ordering instructions.

Circle 492 on Page 129

INDEX OF EQUIPMENT BY ITEM NUMBERS

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405	445	485	525	565	605	645	685	725	765	805
406	446	486	526	566	606	646	686	726	766	806
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424	464	504	544	584	624	664	704	744	784	824
425	465	505	545	585	625	665	705	745	785	825
426	466	506	546	586	626	666	706	746	786	826
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433	473	513	553	593	633	673	713	753	793	833
434	474	514	554	594	634	674	714	754	794	834
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436	476	516	556	596	636	676	716	756	796	836
437	477	517	557	597	637	677	717	757	797	837
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new catalogs..... latest literature

High-Power Servomotors

General Electric Co., Schenectady 5, N. Y.—2 page pamphlet—High-power dc servomotors, designed for fast response to control signals, are described in Bulletin GEA-6831. Design features are discussed and dimension diagrams given. Also included is a chart showing typical motor characteristics and a conversion formula for variable speed motors.

Circle 493 on Page 129

Overhead Cable Conveyors

E. W. Buschman Co., Clifton & Spring Grove Aves., Cincinnati 32, Ohio—4 page pamphlet—Overhead trolley cable conveyors suitable for use in the metal-working, woodworking, and textile industries are described in Bulletin 40A. Data are given on trolleys, tracks, drives, turns, idlers, curves, and hooks. Functional layouts show how to assemble a cable conveyor system.

Circle 494 on Page 129

Slitting Equipment

E. W. Bliss Co., 1375 Raff Rd., Canton 10, Ohio—4 page pamphlet—Rotary slitter for coils or sheet stock is the subject of Bulletin 44-A. Recommended slitting procedures are given and charts list capacities. Also included are suggestions on coil handling, width of cut, and use of entry and delivery pinch rolls.

Circle 495 on Page 129

AC Crane Control

Electric Controller & Mfg. Co., Div., Square D Co., 4500 Lee Rd., Cleveland 28, Ohio—4 page pamphlet—Type VL, a crane control designed for light industrial ac cab or floor-operated cranes, is described in Bulletin 6431. Data are given on the components which make up the control. Available enclosures are mentioned, as are the different applications.

Circle 496 on Page 129

Electrical Products

Buchanan Electrical Products Corp., Hillside, N. J.—12 page booklet—Line of electrical products is described in Catalog C-758. Included in the line are: Connectors, heavy and medium duty blocks for any number of circuits, one-piece terminal blocks, and insulated conduit bushings with a metallic base. Instructions are given on how to splice wires, terminate wires, and insulate splices.

Circle 497 on Page 129

Process & Flow Charting

Labelon Tape Co. Inc., 450 Atlantic Ave., Rochester 9, N. Y.—8 page bulletin—Data are given on pressure-sensitive tapes used to prepare flow process charts and layouts. Sketches show the actual size of process flow symbols and form flow symbols. Also included are instructions for preparing a form flow chart.

Circle 498 on Page 129

Magnetic Tape Unit

Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.—3 page pamphlet—A digital magnetic-tape recorder - reproducer, designated Type 5-680, is the subject of Bulletin 1608. How it can be used with automatic accounting equipment is related. Design features such as self-maintenance and all-metal surface magnetic heads are explained.

Circle 499 on Page 129

Thin-Section Ball Bearings

Split Ballbearing, Div., MPB Inc., Lebanon, N. H.—24 page catalog—Thin-section ball bearings which are constructed with a full ball complement and without loading slots, are described in Catalog 59. Data are given on twelve sizes from 0.6250-inch bore and 1.0625-inch OD through 3.0625-inch bore and 3.8750-inch OD. Notes on the series of midget ball bearings are also included.

Circle 500 on Page 129

Capillary Tubing

Superior Tube Co., 1727 Germantown Ave., Norristown, Pa.—11 page bulletin—Capillary tubing, furnished in lengths up to 3000 ft and tested for flow rate when required, is described in Data Memorandum 11. A definition of capillary tubing is given and materials from which it is produced, tolerances, finishes, and special processing are discussed. Inspection procedures and method of flow testing are explained. A chart shows the maximum lengths for various combinations of tubing outer and inner diameters.

Circle 501 on Page 129

Open-Type Motors

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.—6 page pamphlet—Open-type motors which are unaffected by moisture, dust, dirt, oils, acids, or alkalies, are described in Bulletin 05-51B9040. Reports of tests summarize the protective features. Insulation system is explained; charts show moisture resistance and thermal stability.

Circle 502 on Page 129

Torquing Machines

Dixon Automatic Tool Inc., 2300 23rd Ave., Rockford, Ill.—4 page pamphlet—Unit, designated Auto-Torque Driver, is the subject of Bulletin SD-B1. Data are given on the two models which automatically drive screws and nuts. The precise torque control and sensing mechanism are explained and illustrations display the part handling operation.

Circle 503 on Page 129

Process Instrumentation

B-I-F Industries Inc., 345 Harris Ave., Providence 9, R. I.—8 page bulletin—Data are contained in Bulletin 100-R5 on some of the units used in process instrumentation. Items described are: Flow tubes for metering water, gases, and corrosive fluids; telemeters for remote metering and control; butterfly valves for throttling service in pipelines; and a Conveyoflo meter for continuously weighing and totalizing belt conveyed dry materials. Design features and performance characteristics are noted.

Circle 504 on Page 129

Variable Displacement Pump

Pesco Products Div., Borg-Warner Corp., 24700 N. Miles Rd., Bedford, Ohio—4 page pamphlet—Data are given on a variable displacement internal-external pump suitable for use in high speed, high temperature hydraulic systems. Principle of operation is explained and schematic drawings show zero displacement pump operating position and full displacement pump operating position.

Circle 505 on Page 129

Data and Control Systems

Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio—8 page bulletin—Information is given on AccuRay data and control systems for the plastic industry. Charts compare typical measurements with and without AccuRay. Various process control system components are noted and illustrations show plant installations.

Circle 506 on Page 129

Spot Welding

Taylor-Windfield Corp., Warren, Ohio—12 page booklet—Bulletin SP-20 contains recommended welding schedules for spot welding Inconel X in thicknesses of 0.032 to 0.188-inch. Some of the points discussed are: Properties of Inconel X, welding with triphase machines, welding with single phase ac machines; postweld heat and forging pressure, and spot weld macrographic examination. Numerous charts and graphs aid in explaining the procedure.

Circle 507 on Page 129

OBI Presses

Federal Press Co., Division St., Elkhart, Ind.—20 page booklet—Line of open-back inclinable presses in sizes ranging from 7 to 100 ton capacities is described in Catalog 1014-11-58-10M. The types of presses discussed include: Standard (geared or flywheel drive) type, air clutch, dial feed, and special presses. Features and specifications are noted.

Circle 508 on Page 129

Temperature Controller

Fenwal Inc., Pleasant St., Ashland, Mass.—4 page pamphlet—Temperature indicating controller, designated Series 541, is the subject of Bulletin MC-168. Mechanical design is explained and notes are given on installation, maintenance, and adjustment. Also described are the variety of housing styles, temperature ranges, and switching mechanisms which are available.

Circle 509 on Page 129

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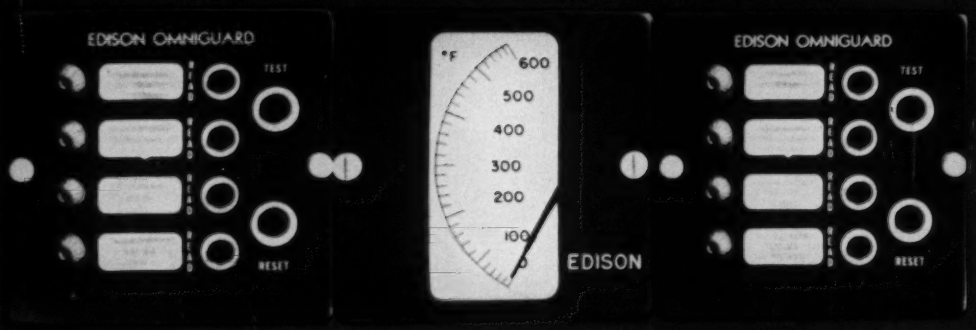
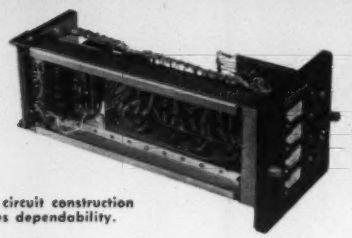
Circle 652 on Page 129





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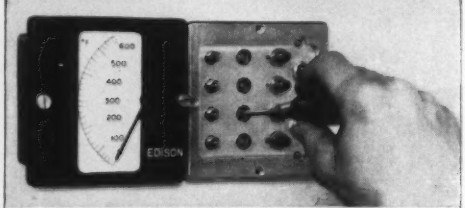

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3. **DEPENDABLE:** Rugged design with highest quality components, no fragile moving parts.

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Circle 653 on Page 129